Theodor Horydczak

Photomicrographs of snow crystals from the W. A. Bentley collection (assembled by W. J. Humphreys)

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Theodor Horydczak

THE BEAUTIFUL PATTERNS OF FROST AND SNOW

SIX photomicrographs of windowpane frost and four of snow crystals from the collection of the late W. A. Bentley, of Jericho, Vt. Windowpane frost seems to gather along abrasions on the surface of the glass to form "the most delicate plumes and outdo the finest lace of hand or loom." The snow crystals are generally hexagonal in outline but of infinite variety in detail. ¶ More than two thousand of Mr. Bentley's photographs of ice flowers, snow crystals, and frost have been assembled into a book by Dr. W. J. Humphreys, meteorological physicist of the U. S. Weather Bureau

THE
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Vol. 34, No. 6 March, 1932

HOUSES OF THE FUTURE

Or the Evolution of the American Home

By John E. Burchard, 2d

DURING the last few years the reading public has been deluged with an astounding array of marshalled fact and fancy relating to suppositional homes of the future. The question of modernizing the building of houses has naturally attracted the serious thought of many who would destroy this last embattled fortress of tradition. The manifold gadgets that have been successfully introduced to the susceptible householder, plus the awe-struck faith with which we accept all of the miracles of modern science, have logically combined to send minds, both deep and shallow, soaring on the wings of fancy. Unfortunately, all that has been needed to pen a few choice words on the general subject of future homes has been an ability to throw words together, a knowledge of the jargon of the house, and an unbridled imagination.

It may be interesting, therefore, to try to extract from the heap of mingled truths and vaporings the kernel of probability, and to hazard a serious guess as to what is likely to become of the home as we now know it in the next 25 to 50 years. With the rapid movements in social structure that seem to be accelerating, with the growth of practical science also apparently speeding up in accordance with some geometrical ratio, it would be dangerous to project the imagination any further.

We must be careful, too, to be very specific about whose house we talk. We shall, for the purpose of this article, confine ourselves to the United States, to a northern climate, and to a district neither super-urbanized, such as Manhattan Island, nor excessively rural. We cannot profitably consider the home of the poor man, the very existence of which entrenched statistics show to be an economic paradox. We certainly need not pay any attention to the home of the rich man who can afford to remodel anything to his personal desire. Accordingly, let us look at what will probably happen to the house of Mr. John Q. Averageman who comes to the city to work every day, who, around his detached house, has a little land on which he grows a tomato and a nasturtium, and who faithfully keeps up with the nearly latest model of refrigerator, radio, and Buick. For this period, unlike any that has preceded it, sings to the tune of the middle class.

The recent popularity of modernistic art and decoration, brought with a great deal of shouting to the United States by our traveled intelligentsia some years after it had fully developed in Europe (having been really initiated in our own country by Frank Lloyd Wright), has led many people to think that new houses of the progressive-minded will resemble the creations of Mallet-Stephens, Le Corbusier, Mendelssohn, and Dudok. Leaving out the question, which is quite seriously a real one, as to whether or not a home owner is progressive-minded in æsthetics, such a result does not seem likely. In the first place, the history of house development has generally been laboriously slow and quite clearly has taken place by evolution and not by revolution. A new form of decoration is quite all right, desirable, and presumably profitable for a store front, for advertising, and, perhaps, for a jazzy New York couple; but under the solid roof tree of the home owner, it has no place. It seems reasonable to expect that such

æsthetic principles as exist in modernism will be accepted only when they go hand in hand with utility. There is one room in the house where this marriage takes place and of it we shall speak at more length a little farther on.

Moreover, a careful study of modern houses evolved in Europe indicates that they have been developed primarily on the thesis (in so far as they are not merely an attempt to be different) that a great deal of light should be admitted to the house through windows and, as open air spaces are at a premium, roofs must be utilized to their fullest extent. The demand for light is less pressing in America where the sun actually does shine more often and more clearly than in Europe. The need for open space is also less keenly felt by the class of population with whom we are dealing than by similar peoples in Europe, who live nearer their cities because they are not reconciled to a minimum of an hour's commuting. Moreover, the desolation of a series of Corbusier's flat-roofed houses during a wet New England snow storm or a driving Minnesota blizzard is at once repellent and ridiculous. What merit has this sort of provision in our climate? It is only remotely possible that extensive development of the autogiro may demand a flat roof.

There is another serious factor about modernism bothering our Buick driver. Anyone who has tried to make his little 6′ x 8′ closet into a modernistic den will know what I mean. There is literally not a thing in our *mélange* of domestic accumulation that has any use whatever in the modern treatment. The wholesale scrapping of good solid value does not appeal to Mr. Average Citizen.

When we come to the structure of the new house, we tread on more dangerous ground. There is no doubt that something has to be done about it. Essentially, we have added nothing new to this structure since the Tudor period. Actually, a modern person could be and often is perfectly happy and comfortable in an Elizabethan or Jacobean house which has been modernized in its equipment. The building of houses is undoubtedly backward and needs serious study. And it is getting it. A great many very able men are working diligently on the problem. The general key to the solution seems to be the placing of different parts of the house on some sort of mass-production basis. This is not the place to raise the very serious question as to whether mass-production is economically sound in the long run when applied to goods that have long life and are not for immediate consumption. The big difficulty with the mass-production idea, even if the economic premise is sound, lies not in lack of flexibility, in sales resistance, or any other factor of that sort that may temporarily obstruct its progress. It lies in the fact that the mass-production principle needs mass-production to accomplish its economy and that the house susceptible of mass-production is sure to cost a great deal more in the first instance than the traditional structure. The *entrepreneur* has, therefore, many difficult days ahead of him before he can get sufficient output to justify his thesis. None the less, the house-building industry is a big one, aggregating many billions of dollars in any normal year, and some form of combined effort may change our structure quite radically. It would not be appropriate for me to endeavor to say in what way this will be done, if 'tis done.

One thing is certain. Any structure, even one that is completely non-revolutionary, must be given sufficient study in the near future so that each artisan does not cut and hack apart the work of his immediate predecessor in the process of building. In other words, there must be adequate preliminary provision for the placement of the accessories which are occupying a greater and greater portion of the entire amount allotted to the cost of a home. Every day some new piece of machinery is being offered to, and accepted by, the public until in this year, 1932, the mechanical equipment of the average home probably numbers at least as many moving parts as the stabled Buick in its attached garage. Curiously enough, despite this tremendous increase in mechanization, occurring principally in the last decade, the saturation point seems, by no means, to have been reached and it is to accessories that we must look for the bulk of the potential development of the immediate future.

First, however, we may note two or three evolutions of the plan which have partly taken place already and which stem directly from our mechanical civilization. The first is the gradual elimination of the porch. In a past, not so remote as to be forgotten by some of us who still feel pretty young, the front veranda was an essential adjunct to American life. We lolled on it in swings and read our books, drank our afternoon lemonade, and even played our evening whist. From its vantage point we watched the placid life of the neighborhood with a mild and friendly interest. But that was in the age of peace when the snort of an occasional buckboard exhaust was the only intimation of the advent of a period when rotation would become as significant as translation. There is no satisfaction in sitting on the front porch now, looking at automobiles as like one another as peas in a pod, filled with people none of whom we have ever seen before nor will ever see again.

Thus the front porch has developed into a so-called sun porch, which is really a sort of living room and more often than not opens on the back yard, where we can look at our little garden and have a modicum of privacy. This development is of great significance socially. It means that more and more we will place our kitchens and service rooms on the street side and take our living rooms, where they belong, into the more secluded areas of our property. It is further possible that in our large cities privacy may be obtainable by a revival of the inner court, or atrium, such as used in Rome and Pompeii. The immediate objections to such a revival would be our arduous climate and the dirt of the contemporary city. But neither of these is insurmountable. Cities may be cleaner in the future and, within the bounds of a modern metropolis, temperatures are materially higher than in the outlying vicinage. That by further evolution we will eventually retreat to the cellar when airplanes are common overhead visitors is by no means an insane idea.

There is an unquestioned tendency to rejuvenate that same cellar and make it into habitable quarters. At present the development is largely in the form of game rooms and bars, but the game stage will pass, at least temporarily, and it is conceivable, too, that the private bar will become only a rudimentary organ of the house body. A more logical development for the cellar spaces will be in the nature of service rooms, such as dryers for laundry and workshops in which our male population can indulge in craft work, carpentry, pottery, weaving — a habit which we shall all soon have to adopt as a means of utilizing spare time if we are to avoid collective insanity.

National Park Service

Kaibab suspension bridge which carries the only roadway across the Grand Canyon in Arizona. The bridge, which is 440 feet long, is supported from eight, one-and-a-half-inch cables. It is provided with a structural steel truss acting both in a stiffening capacity and as guard rails. It is further stiffened by two, one-and-a-half inch wind cables. The south approach of Kaibab trail to the bridge is through a tunnel 100 feet long, cut from solid granite walls of which the inner gorge is formed

The evolution of the dining room is also long overdue. Whether we like it or not, our type of democracy is making the servant problem more and more difficult and it is quite possible that a good American servant will soon be as extinct as a dodo. This precludes the possibility of eliminating the dining room altogether by making a larger living room and serving meals in this — a reversion to the old Norman hall, which has much to recommend it but which is socially impossible, when entertaining the boss, without servants. The reader who happens to remember some charming dinners served under exactly these circumstances will realize that the hosts were *not* Mr. and Mrs. John Q. Averageman.

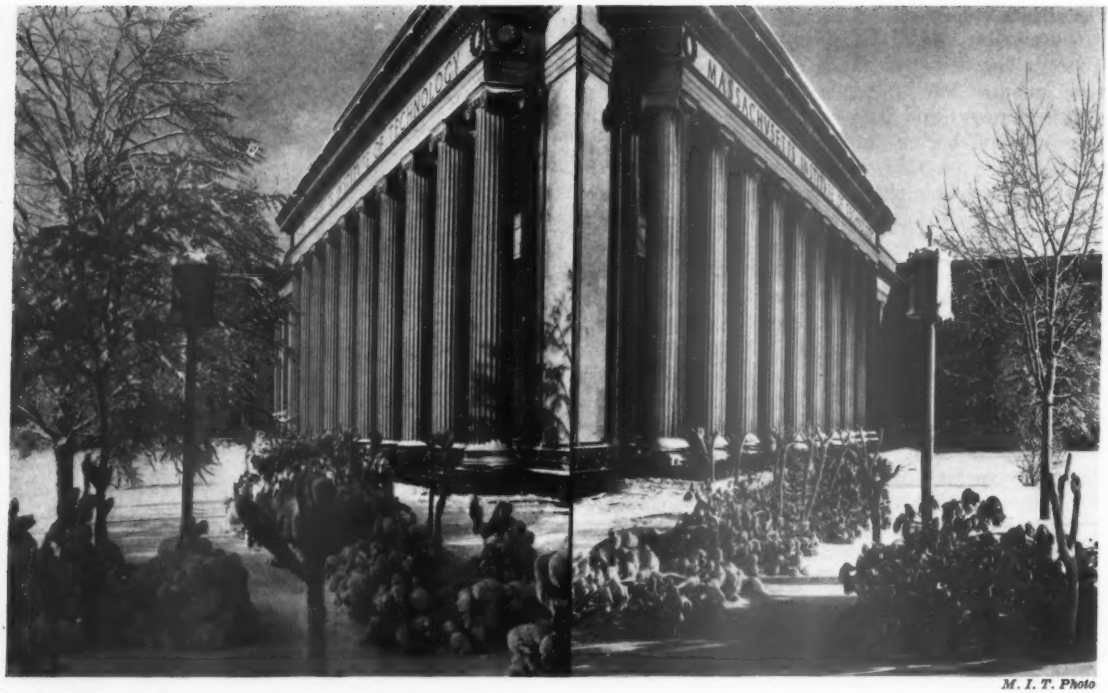
None the less the dining room is the most inefficient room in the house and its space is used only about 12% of the day at best and more likely in these times for but one meal. A dual function is, therefore, indicated and I venture to suggest that this will come through a recrudescence of a room we have long abandoned — the music room. In the days when every respectable American family owned a piano and every boy, however unmusical, could drum out the "Miserere" from "Il Trovatore," it was essential to have a room in which music could be performed without disturbing the peace of the rest of the family.

Today the growth of radio sonority, attempting to duplicate the full breadth of an 110-piece symphony orchestra, the development of television, which has been threatening to be successful for a long time, and more particularly the undoubted spread of home cinema, point to the need of a room that may contain a projection screen and the various and multiplying electrical receivers. Such a room could be nicely combined with the dining room by using available ingenious contrivances for getting the table out of the way, or the table could be used as a support for ping pong or billiards. The added advantages of thus removing the radio from its usual sphere of action in the living room would be: (1) that in the dining room it would cover up the feebleness of our conversation; (2) that reading might be reborn among some of our householders. May heaven forfend! the other possibility — that there be a receiver in every room turned on as readily as an electric light.

It has frequently been suggested that the house be made into a large enclosed place and that partitions be movable, thus allowing the householder to change his rooms at will à la Japan. Leaving out all question of furnishing and decorations, there seems to be nothing practical in the suggestion until the time when we become completely indifferent to the personality of a locus. At present all of us have our favorite house corners and we simply could not stand to have the dishwasher moved into them when it was time to give the baby a bath or Roger his music lesson.

Bathrooms cannot be multiplied forever and some bright mortal is very soon going to discover that he can take a leaf from an old book and build his toilet and bath in separate compartments, thus about doubling the effective use of the services there provided. We will probably go even further in this direction and separate the lavatory from the bath.

So long as we have combustion units at all, it is perfectly evident that the mechanical handling of fuel and ash is bound to be universal very soon — whatever may be the fuel of the future. If the fuel is a dusty one, such as coal, it will be kept in a bin which has no contact with the cellar save through an automatic stoker and dust will be banished. Gas and oil fuels, already developed with considerable success, (*Continued on page 262*)



M. I. T. Photo

EDUCATIONAL OBJECTIVES AT M. I. T.

Adapting the Institute to New Demands and a Greater Usefulness

By Karl T. Compton

Editorial Note: *Those who are concerned with technical education, whether at M. I. T. or elsewhere, will find the following discussion provocative and prophetic. President Compton first presented it in the form of an address at the Annual Dinner of the M. I. T. Alumni Association on February 6.*

AT THE present time every aspect of our civilization is being subjected to scrutiny to discover if it be good or bad, useful or useless, effective or ineffective. In every activity we are inquiring, "Is this thing worth doing and, if so, is it being done in the most effective possible way?" It is particularly appropriate, therefore, that we should consider critically and constructively the purposes and policies of the Institute.

When Mr. Bradley Dewey, '09, President of the Alumni Association, suggested that I discuss this topic, I at once thought of one of the first letters which I received after I had decided to cast my lot with you in the service of the Institute. It was from an old and wise friend, with long experience as an administrator in another educational institution. He wrote: "Don't make the mistake of most newly appointed college presidents and make a speech about educational policies. The pressure to do this is very great. Most new presidents feel that they have to say something along this line, whether they have anything at the time to say or not. They scrape together something to meet the emergency. People say kind things about it, so they feel encouraged to try the same thing again in slightly disguised form, and before long they really begin to believe it themselves. From that time on they are hopeless. Don't enunciate any educational policies until you have lived with the job at least a year."

I believe that I have, until now, avoided educational sermons. But now I am going to "fall from grace" or "rise to the occasion," according to your verdict, for three good and sufficient reasons: first, President Dewey's request; second, the spirit of the times to which I have alluded; third, the fact that many of you have sons, daughters and young friends who look to you for advice regarding their training, and you therefore have to face problems and questions on whose solution the things which I have to say have a direct bearing.

The general plan of my remarks is very simple. First, and most important, *What are our objectives?* Second, *What methods or policies are being followed in the hope of attaining these objectives?* Finally, *Are these objectives worth striving for and can we improve our methods and policies?*

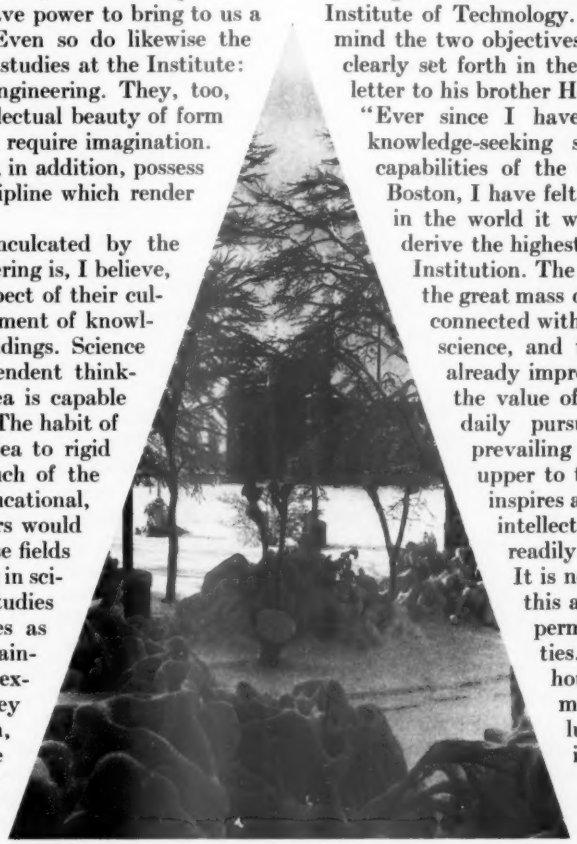
Objectives. There are two, and I think only two, objectives of the M. I. T. One is the training of our students to understand and be adaptable in the world in which they live. The other is the application of science to human welfare through the advancement and application of knowledge, and the training of experts.

Cultural Training. What do we really mean by culture? According to the dictionary, culture is "the training, development, or strengthening of the powers, mental or physical, or the condition thus produced; improvement or refinement of mind, morals, or tastes; enlightenment or civilization." There was a time when knowledge of science, and particularly knowledge of things useful, was considered foreign and even antagonistic to culture. Literature, music and art held the center of the stage, as well as both the wings. It was a cultural pursuit to delve into the study of the tools and machines of the cave men or the Egyptians, but not to try to understand the science and the machines of the civilization in which we actually live.

In recent years this viewpoint has rapidly changed. Science has so permeated our civilization that, even though it be imperfectly comprehended by the majority of people, it nevertheless has every bit as universal an appeal as do literature and art. Nowadays that man or woman is not cultured who is ignorant of, or uninterested in, the science and engineering art. It is not possible to understand our environment or to live intelligently in it without an understanding of science and engineering.

I should define culture as "the sympathetic understanding and appreciation of life." Life has various aspects, emotional and intellectual. "Music hath charms to soothe the savage breast." In literature we have access to the finest thoughts and feelings of mankind. Art brings to us beauty of form, color and expression. All of these, and religion, have power to bring to us a mystical uplift of feeling. Even so do likewise the particular objectives of our studies at the Institute: architecture, science and engineering. They, too, express symmetry and intellectual beauty of form and relationship. They, too, require imagination. But science and engineering, in addition, possess a power and exercise a discipline which render them unique.

The mental discipline inculcated by the study of science and engineering is, I believe, at least as important an aspect of their cultural value as is the acquirement of knowledge regarding our surroundings. Science requires straight and independent thinking. Every hypothesis or idea is capable of definite proof or disproof. The habit of mind that submits every idea to rigid test is of utmost value. Much of the loose thinking in social, educational, political and economic affairs would be avoided if workers in these fields could be given a real training in scientific thinking. Scientific studies possess the same advantages as do the classics in giving a training in precise thought and expression, but in addition they afford training in observation, in inductive and deductive reasoning, in exact checking of hypotheses and assumptions. And at the same time they are the key to the understanding and control of our environment.



At the M. I. T. our course of study includes language, literature, history, economics, art, pure and applied science. We emphasize science more than do the so-called liberal arts colleges. In view of the facts mentioned above, our course should inculcate particularly valuable habits of mind and, in the truest sense of the word, instill a peculiarly fundamental culture. And, if it be true that science pervades the culture of this early part of the Twentieth Century, we have only to read the signs of the times to predict its continually increasing importance and influence.

Thus I submit that Technology need offer no apologies for its course. It has been, and is, in direct line with the trend of the cultural developments of the age.

Application of Science to Human Welfare. This is the second of Technology's objectives. The notion that science is useful as well as intellectually ornamental is of relatively recent origin, speaking in terms of the age of civilized man. Benjamin Franklin was one of the earliest preachers and practitioners of this doctrine, with his contributions to the art of heating, ventilating, navigating and meteorology. His contemporary, Count Rumford, spent much of his equally active life in developing science for the service of mankind, and founded the Royal Institution of Great Britain specifically to aid the poor through the practical applications of science. Fifty years later, William Barton Rogers was working for the establishment of the Massachusetts Institute of Technology. That Rogers had clearly in mind the two objectives which I am discussing was clearly set forth in the following quotation from a letter to his brother Henry, dated 1846:

"Ever since I have known something of the knowledge-seeking spirit, and the intellectual capabilities of the community in and around Boston, I have felt persuaded that of all places in the world it was the one most certain to derive the highest benefits from a Polytechnic Institution. The occupations and interests of the great mass of the people are immediately connected with the applications of physical science, and their quick intelligence has already impressed them with just ideas of the value of scientific teaching in their daily pursuits. Besides this, the high prevailing taste, diffused from the upper to the lower classes of society, inspires an earnest appetite for richer intellectual food than they can now readily obtain."

It is not necessary to point out to this audience how applied science permeates our lives and activities. Our food, health, clothing, houses, transportation, communication, conveniences, luxuries and necessities all involve a high degree of scientific knowledge in their development and technical skill in their production.

It would require the labor of five thousand million slaves to equal the energy that is daily used in this country and obtained from coal, oil, gas and water power. It is the great productive power made available in machines by the engineer that provides us with so many desirable things in life — material things like comfortable and convenient homes, or railroad trains or telephones, and immaterial things like time for schooling and recreation.

Because of its basic value to society, this second of our objectives is also fully deserving of our support. It is an even more essential service to society now than ever in the past, because scientific and technical progress have advanced to such an extent as to require a higher degree of training than ever before in order to "carry on."

To sum up this phase of my remarks, therefore, I would say that M. I. T. has been in the past, and can be even more in the future, a cultural and economic asset of far-reaching significance to this community, to this country, and to the world.

Some Problems of Educational Policy

LET me now direct your attention to a few questions regarding our methods and policies. Some of these questions have to do with policies which are traditional and have become firmly established in our habits of thought. They remind me of an illustration used by my friend Dr. Swann, Director of the Bartol Research Laboratory. Dr. Swann gave to a student the problem of calculating how long it would take for a ball to reach the ground after being dropped from a tower 100 feet high. After puzzling over this problem for some time the student came up to ask the weight of the ball. Dr. Swann asked him if the weight of the ball made any difference, and the student replied, "Of course! It is impossible to make calculations for a ball unless you know its weight." So Dr. Swann told him he could take the weight of the ball to be 5 ounces. A little later the student came up, still in mental distress, and wanted to know the size of the ball and its color, saying that of course a ball must have some size and color, in fact it was impossible to think about a ball without thinking of its size and color, and he was told that he could consider the ball as 9 inches in circumference and of the color of a baseball. So the student went back happily and soon turned in the correct answer. When Dr. Swann pointed out that the weight of the ball had cancelled out in his calculations and that he had not used the size and color, and that the answer would be the same even if it had not been a ball at all, and asked him then why it was necessary to know the weight, size and color, the boy replied that he had always been accustomed to think of balls as having size, weight and color, and that he had not seemed able to grasp the problem until he knew what these characteristics of the ball were.

In a similar way it is worth while for us to ask ourselves the question as to what extent our own methods are determined by the way in which we have been accustomed to think about things, and to what extent our attention has been focussed on the weight, size and color of the ball instead of being centered on the essential features of the problem.

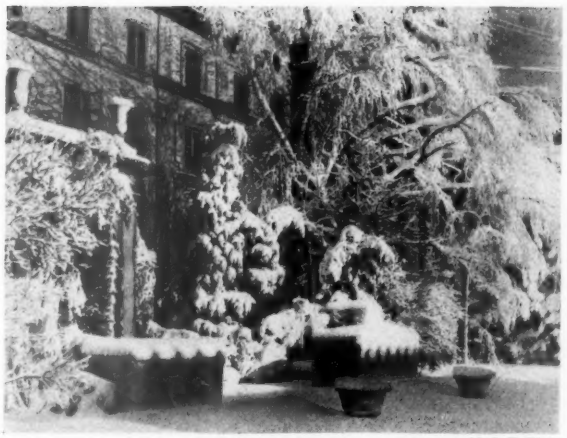
Our curriculum is divided into various departments, such as Civil Engineering, Mechanical Engineering, Electrical Engineering, Chemical Engineering, Physics, Chemistry, Architecture, and so on. Within these various departments are special courses on such things as steam engines, highway construction, railroad transportation, electrical communications, fire assaying, relativity, and so on. The question arises as to whether these subdivisions and these topics represent the things which we would emphasize if we faced the problem of organizing our work with all our present knowledge and free from prejudice, or whether they exist in part as relics of past activities and habits of thought. It is certain, I think, that an intelligent study of this question will show that we are now focusing too much attention on some things whose usefulness has been superseded by other things which we have not as yet adequately considered. A committee of the faculty is at present actively engaged in studying this problem and it remains to be seen whether their consideration will lead to the recommendation of a sweeping modification in our departmental and course organization, or whether the suggested changes will be of a minor nature. In any case, it is certainly wise to give serious thought to such matters from time to time.

A second question relates to our methods of admission of students from high and preparatory schools and as transfers from other colleges. The present methods have worked well and perhaps would be vigorously defended if questioned. It is possible, however, that new elements in the situation may make it advisable to introduce modifications in our plan of admission. For example, the new MacKinnon rating system is adequate automatically to take care of admissions on trial which heretofore were a constant source of annoyance because each required personal administrative attention and initiative. Furthermore, the development of engineering schools all over the country has changed the aspect of engineering education, so that we are destined to receive a larger and larger proportion of students as transfers to upper class or graduate work from other engineering schools. Again, there are an increasing number of Technology Alumni and others able to give their sons whatever education appears best to them and who wish to have their sons take first a course in a liberal arts college, followed by a professional course at Technology. Again, it is becoming increasingly evident that the College Entrance Board plan of admission is essentially an Atlantic seaboard affair, and that the high schools and preparatory schools of the great section of the country west of the Alleghenies not only do not encourage their students to take our College Entrance Board examinations, but in many cases definitely advise them against it. All of these situations suggest that we might advantageously modify our plan of admissions so as to encourage the right type of transfer student and to facilitate the admission of high-grade students who are at present deterred by the limitations of the College Entrance Board system.

A third question relates to the policy of appointments and promotions on the instructing staff. In many quarters there has evidently been a fairly well-defined feeling that any graduate who makes a very good

record can look with considerable assurance to appointment as an assistant if he desires it. The assistant has a general feeling that he has a right to expect promotion to an instructorship, and the instructor has a similar reasonable expectation, which sometimes amounts to a feeling almost of a right, to appointment to an assistant professorship. In some ways this attitude is a very laudable one, for it shows ambition and interest and is a spur to good performance. On the other hand, there are some unfortunate features in such a procedure. There cannot possibly be found enough places in the higher grades of appointment to take care of all of the assistants and instructors who are needed and whose performance is satisfactory, and failure to receive such promotion may result in a man's remaining for so long a time in a subordinate position as to sap his enthusiasm, self-respect, and general value to his department. At the same time he may pass the age at which he can readily find openings in other places, and his presence blocks the way for introducing continually new blood and vigor. A number of educational institutions have adopted the definite policy of limiting terms of appointment of assistants and instructors to a maximum of not over three or four years, with the understanding that at the end of this term the instructor for whom a place cannot be found in higher rank must seek a position elsewhere. In every institution of my acquaintance which has adopted this plan, the reaction on the institution and also on the *esprit de corps* and success of even those instructors who are not promoted has been excellent. Would not such a plan have a stimulating effect in our own Institution?

The fourth question is one which I have discussed on another occasion and has to do with the relative emphasis which we should give to fundamental as compared with highly specialized or technical subjects of study. A generation ago our industries needed men trained in various techniques and looked to institutions like ours to supply them. There has, however, been a great change in the situation during the past 30 years. The number of specialties has multiplied tremendously, and along with them the variety of technicalities which must be known to operate our highly complex system. Paradoxical as it may seem, this change makes it more and more important that our technological schools should lay relatively more emphasis on fundamental and less on specialized studies. One reason for this is that neither the student nor his professor can possibly foresee what special knowledge or technique the student will be called upon to exercise after he goes out to his life's work. If his training has been in a highly specialized line, the chances are that he may never have the opportunity to use it. If, on the other hand, his training has emphasized the fundamental principles of science and engineering which underlie all specialties, he will be in a position intelligently to attack the variety of specialized problems which he will meet. A second reason is found in the highly organized character of the large industries which employ so many of our graduates. These industries prefer and are equipped to train the men who come to them in the particular jobs which they are to do, and their leading men have made it very clear that the men whom they wish to employ are men who have a solid



M. I. T. Photo

foundation of instruction and training on which they can build, and not men for whom an attempt has been made to give a training in the manipulations which they will be expected to carry on in their industrial work. It is realized that these considerations may apply more strongly to certain fields than to others, but I believe that it is generally recognized that relatively increased emphasis on fundamental lines of study and training is the thing toward which we should work in all branches, except perhaps for a few new and pioneer branches of applied science in which the technique is still being developed and in which such training as can be had must be attained in institutions like ours where the development is taking place.

Is There an Overproduction of Technically Trained Men?

PERHAPS no question in regard to our activities is asked more frequently than the question as to whether we and the other technological schools may not be turning out more technically trained men than the activities of the country can absorb. This is an extremely important question, the answer to which should have a controlling influence on our policies. I should like, therefore, in conclusion, to direct your thoughts to some of the aspects of this question.

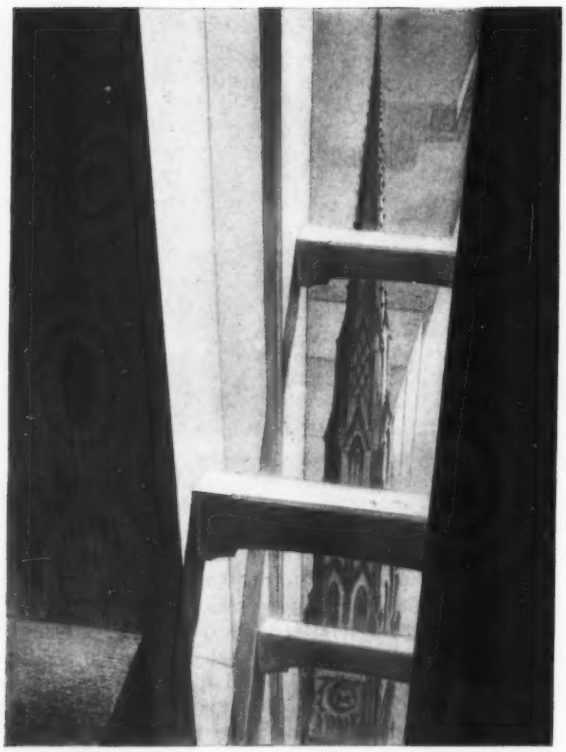
It is certainly true that in this as in every other field of life competition is becoming more and more severe. In the early pioneer days there was, comparatively speaking, no such thing as competition. The entire country and all its resources lay open for the taking. To take advantage of the resources required initiative and hard work, but it involved relatively little competition. The same thing was true of industries such as the electrical and chemical industries in their infancy. The whole field lay open before them to be conquered. The same thing again was true of the opening of technological schools. The field of applied science was a virgin field. It had to be opened up by hard work and by education of the people to realize its potentialities, but there were many more opportunities than there were men to take advantage of them.

(Continued on page 266)

INDUSTRIAL

ITS RESTORATION AND THE

By Robert F.



From a pencil and crayon drawing by Leopold de Postels of the de Postels Studio

IN THE January Review, Professor Ralph E. Freeman discussed the theory of industrial equilibrium. Briefly, our industrial structure is in a state of stable equilibrium when all commodities are being produced in the right proportions. When we give a disproportionate share of our efforts to the production of certain types of goods, symptoms of distress appear which are quite analogous to those of an individual who has persisted in an unbalanced diet. In theory, the law of supply and demand automatically cares for a temporarily unbalanced situation by causing prices of the overproduced goods to fall. This causes labor and capital to be attracted away from the industries where overproduction exists into others where production is relatively low and the outlook for profit correspondingly greater.

In the long run, this process does operate. In our present complex, industrial society, however, there exist many frictional forces which restrain the operation of fundamental economic forces until the unbalanced condition has passed certain limits. These hampering influences possibly permit smoother sailing of our economic craft in moderately calm waters, but in stormy seas they augment the violence of the basic stabilizing forces, and cause extreme discomfort to the passengers.

One of the causes of friction in our present economic order is the tendency for fixed costs, represented by plant and equipment, to become a constantly larger part of the total cost of production. This, together with the tendency toward special-purpose equipment, makes it constantly more difficult to get capital out of an industry. If an industry has become overexpanded through overinvestment in specialized buildings and machinery, the period required for the law of supply and demand to correct the situation may be roughly measured by the lifespan of the productive facilities involved. The bankruptcy of individual producers does not in most cases mean the junking of their plants. Consequently, the only corrective influence possible is the curtailment of the flow of new capital into the industry.

Here, however, we find another lag in the tendency for the investment of new capital to be artificially directed. It has been the policy of many corporations to retain and reinvest in the business a considerable proportion of their corporate earnings. To the extent that this is done, the flow of funds into industry is subject to the judgments of boards of directors, rather than to the free working of economic forces. The policy is harmful to the extent that these judgments fail to be economically sound. There is another artificial direction of capital in the policies of investment houses. Finding it easier to sell securities of industries with good records of earnings in the past, these houses have promoted such issues, going so far as to seek out opportunities for new investments in particularly popular fields. It does not necessarily follow that because an industry has in the past used its capital profitably that it can efficiently utilize additional funds. The result of these two artificial influences has been in many cases the further expansion of productive capacity in already overexpanded industries.

This maldistribution of new funds has also been due in part to the fact that it has been possible to a certain extent to create an artificial and temporary demand for the products of certain industries. High-pressure selling and advertising methods have made it possible to broaden markets without decreasing prices, creating, as it were, a new kind of elasticity of demand. In so far as business men have used selling pressure to stimulate demand beyond a level which can be maintained at reasonable cost, they have delayed, but not avoided, the inevitable process of readjustment.

The operations of the law of supply and demand are further hampered by the increasing ratio of distribution costs to retail prices, which operates to diminish the effect of elasticity of demand. In the case of many goods, the cost of production does not represent more than 25% to 50% of the price the consumer pays. Savings in production costs usually come about through commitment to increased volume. The process of distribution, however, seems to operate under diminishing returns. Consequently, the savings in production costs, through additional investment, often prove insufficient to influence prices enough to increase consumption by an

EQUILIBRIUM

PART THE ENGINEER MUST PLAY

ELDER

amount sufficient to earn a profit on the new investment. Business men, as a class, have been slow to sense the effect of costs of distribution in limiting the elasticity of demand.

When the full effect of these frictional forces has been overcome, and the operations of economic processes begin to make themselves felt, we have a condition of sterilization of that portion of our wealth which constitutes our overinvestment in overexpanded industries. A period of readjustment occurs, which usually results in writing down investment values and repaying the surplus capital in the form of lower prices. Characteristic of this period of readjustment is the accumulation of additional savings, which serve, when they are called into use, as the basis for new advances in industry.

To call these new savings into use, there must be possibilities for their profitable utilization. Since a severe depression affects our entire society, not only is spending power reduced, but a condition of fear paralyzes a large portion of even the reduced power to spend. Money in the bank, or even gold in the safe-deposit vault, becomes more attractive than formerly, and goods for consumption become less attractive. The process of deflation proceeds to extremes as great as those of the previous inflation.

The creation of possibilities for profitable use of the idle funds accumulated during depression depends on a resumption of normal spending for consumption. Attempts have been made, possibly prematurely, to induce normal spending through patriotic motives, as in the persistently attempted "Buy Now" campaigns. These attempts indicate a complete lack of understanding of consumer demand. Consumers, in the mass, are innately selfish. They buy because they want. The type of selling which stimulates wants and creates desires is effective to a considerable degree in inducing greater spending. Its effect, however, is limited by considerations of cost, and it cannot do the whole job.

The most vital influence for increased spending is the creation of new products or the radical improvement of old ones. The desire to attain a higher standard of living and to enjoy new comforts is infinitely stronger than the desire to have more of existing goods. When a man has one automobile, it is harder to sell him a second than it is to sell him a radio or an electric refrigerator which he does not possess. It is perhaps significant that the most conspicuous examples of concerns which have resisted the depression are those which have brought out totally new products or made their old products decidedly more attractive to consumers.

New developments of this sort vastly stimulate the process of recovery from depression. Totally new undertakings, started after deflation of commodity, labor, capital, and land costs has taken place, find it easier to earn profits than old industries which are still struggling with readjustments. By showing new possibilities for profit, they draw idle funds into use. The building of factories and machinery for their manufacture increases employment, and not only creates new purchasing power for the new articles, but brings into the market people who have been forced to curtail their purchases of existing commodities. Thus, industry as a whole is stimulated. Increased demand arrests the falling price trend; profits begin to be made in other industries; and the up-swing of a new cycle commences.

From a pencil and crayon drawing by Leopold de Postels of the de Postels Studio

There is a serious question as to whether a theoretically correct rate of invention of new products might prove a stabilizing influence in all phases of the business cycle. It is at least an interesting speculation to wonder if, during our next period of expanding business, a sufficiently rapid acceleration of development of new goods to absorb most of the proceeds of industry would suffice to maintain a dynamic balance of our industrial equilibrium. In the past decade the prime interest of management has been to improve the efficiency of manufacturing existing products. In doing so, capacity in many industries was increased faster than consumption. If satiation of markets, rather than maldistribution of income, was primarily responsible, and there is at least some evidence of this, then a policy of devoting at least as much attention to the creative type of research as to the analytical type would seem to promise beneficial results.

(*Concluded on page 270*)

THE TREND OF AFFAIRS

Heating Homes by Radiant Energy

IN his article on the house of the future (page 239), Mr. Burchard notes a growing interest in radiant heating. What is this system of heating and how does it differ from present methods?

The conventional heating devices now in general use accomplish their purpose by convection, the transfer of heat by masses of warm air set in motion by steam and hot water radiators, and hot air furnaces. In contradistinction, the pleasant warmth of the open fire is heat produced by radiant energy. In central radiating heating systems, however, radiant heat is produced, not by an open fire, but by radiation from coils of pipe or hot air ducts hidden in panels within walls, ceilings, or floors. The radiation propagated by these heating panels is distributed equally in all directions after the manner of light waves, and is reconverted into heat in the body by which it is absorbed. With radiant heat lower temperatures will give the same degree of comfort as higher temperatures with other methods.

The heating units of most radiant energy systems must necessarily be incorporated in the building during an early stage of construction. Most of the present systems consist of continuous or manifold pipe coils heated by steam or hot water. Electrically heated panels, believed to be the most efficient method of producing radiant heat, have been used in some installations, but until electricity becomes cheaper, this method is not likely to be adopted for general use. Still another method, developed by A. H. Barker, an English engineer, uses flat metal radiating surfaces. These may be installed across a finished wall or ceiling with a suitable molding to give the appearance of a raised flat panel. The advantage of this method is that it can be installed in old buildings without a great amount of alteration.

Installations in floors have proved efficient, although heat from this source may become uncomfortable for those with tender feet. Walls and ceilings now seem to offer the most acceptable location for radiant heating panels, which may be placed in such a manner as to assure a remarkably even temperature.

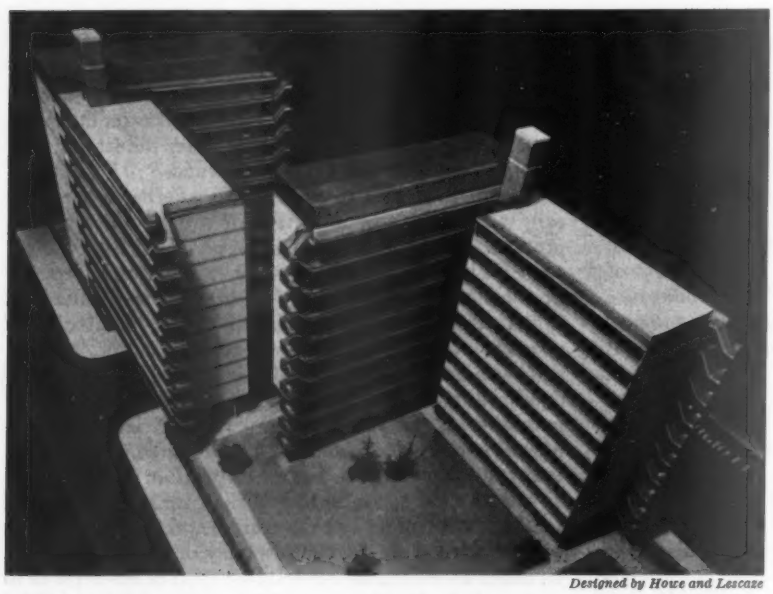
The production of heat by radiant energy is much slower than by convection heating and once the building is warmed by this method, it likewise takes a long time to cool. These facts might prove to be a disadvantage in certain climates where heat must be controlled to meet rapid changes in temperature.

C. G. Heys Hallett, an English engineer, who discussed the subject before the Institute of Heating and Ventilating Engineers in London recently, declared that the ideal radiant energy heating system must possess these characteristics: (1) The surface temperature of the units must be reasonably high (but not high enough to "burn" the air or dust contained therein) in order to

(a) obtain a large percentage of radiation,
(b) permit the intensity of radiation to be varied over a wide range, and
(c) limit the area of surface required.

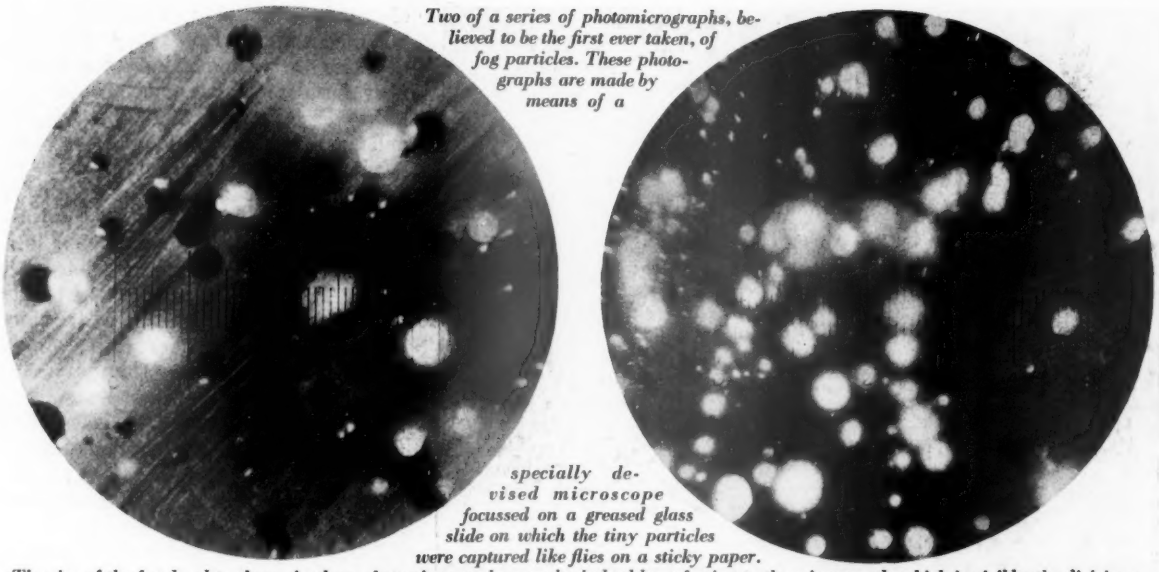
(2) The surface must have a high emissivity. (3) The units must be of such a nature that the direction of the radiation emitted can be controlled in order that the distribution may be perfected and modified to suit conditions. It is also important that as little radiation as possible should be allowed to fall on external walls. (4) The system must not be sluggish in operation. The rate of heating and cooling of the units should not be sufficiently great to cause rapid fluctuations in radiation intensity; it must be possible to obtain a state of comfort with rapidity. (5) The units must not depend for their effect on raising the temperature of the structure of the building, as this not only introduces a high degree of sluggishness, but greatly increases the heat loss from the building.

Although the public has heard little of the progress of radiant heating, many important buildings in England are now warmed by radiant energy. In this country radiant heat is used in the British Embassy in Washington, and several residences



Designed by Howe and Lescaze

Model of a proposed apartment group to be built of steel and to stand 14 feet above the ground on stilts. Beneath the elevated first floor would be playgrounds and parking spaces



Two of a series of photomicrographs, believed to be the first ever taken, of fog particles. These photographs are made by means of a specially devised microscope focussed on a greased glass slide on which the tiny particles were captured like flies on a sticky paper.

The size of the fog droplets shown in these photomicrographs may be judged by referring to the micron scale which is visible, the divisions of which are 2 ten thousandths of an inch apart. Below is shown an observer, H. C. Houghton, '25, looking through the microscope designed at M. I. T. and used at the Institute's experimental station at Round Hill, Mass.

to be heated by this method are now being built near New York. England's most impressive demonstration of the efficiency of radiant energy heating is in the great Liverpool Cathedral, where heat is carried in ducts beneath the floor from which the energy is radiated. The floor of the cathedral is maintained at a temperature of 68°, which was found the proper condition for comfort, and tests at a height of 97 feet above the floor showed a steady temperature of 58.5°, compared with 60° at a height of four feet above the floor. This installation recalls the method of the Romans, called the "hypocaust." This system carried the hot gases from a fire in the basement through ducts or flues built in the floors and walls.

Several English public buildings, among them a number of schools, hospitals, and auditoriums, are equipped with radiant heat, and studies of these installations indicate that this method has many advantages over the present systems.

Some investigators in this field have made interesting studies of the efficiency of radiant heat with scaled models of various types of rooms and buildings. In view of the fact that radiant heat is propagated in the same manner as light waves, it is possible to carry on such research by the use of lights, the degree of illumination corresponding to the amount of radiant heat necessary.

Drugs, Deceit, Detection, and Dementia

"CHILDREN and fools," they say, "tell the truth." It is easier to tell the truth than it is to lie, for a true answer to a question is the natural and spontaneous reaction to a comprehension of its purport. No thought is needed to tell the truth, but the devising of a lie requires a certain amount of intellectual effort. Children haven't learned the art and fools haven't the mentality to practice it. A person who makes a true answer responds quickly, but one who has to think of a plausible falsehood is delayed in his response. The latter, when cross-examined, cannot avoid delaying his false answers, but he can deliberately delay his true answers, and the reaction time is not necessarily an indication of the truth or falsity of his replies. The "lie detector" is an electrocardiograph, a device for making a permanent record of the action of the heart, and the heart performs differently when one is telling a lie.

Scopolamine, or "twilight sleep," has been heralded as the "truth drug," for a person who is under its influence does not give false answers, at least not intentionally. It is the same with actual sleep. If we waken a sleeper by asking him a question, we get the true answer unless — "to sleep, perchance to dream, ay, there's the rub" — unless the response may chance to be determined by a dream in which the sleeper is involved at the moment when we awaken him. An individual under the influence of scopolamine will give spontaneously the answer which his drugged mentality accepts as true. If it has to do with pink crocodiles with blue eyes dancing on the lighting fixtures, so much the worse for the questioner. Scopolamine has the further disadvantage that it makes people easily subject to suggestion. A series of well-planned, leading questions addressed to an innocent person who has been dosed with the "truth drug," a series culminating with the question, "You murdered Mr. X with an ax, didn't you?", might easily provoke a response of "Yes, I did, with an ax."

Charles R. Phipps

Winter in the quarry

Hyoscyamine is similar to scopolamine in its action, and it has to a remarkable degree the power of producing suggestibility. It is supposed to be the drug used by Circe in changing Ulysses and his men into swine. She perhaps introduced into their food the herb which contains the drug, and then after an interval urged them sympathetically, "You are pigs, aren't you? Why don't you act like pigs? Be yourselves. Get down on all fours, and wallow and grunt." At any rate, the herb, hyoscyamus, and a psychologist like Circe could have made them do it.

Dr. Erich Lindemann has been recently experimenting at the Psychopathic Hospital of the State University of Iowa with the synthetic drug, sodium amytal, a derivative of barbituric acid related to the well-known drugs, veronal and luminal. He finds that a small dose of the drug, insufficient to produce anæsthesia, causes a feeling of strength, self-confidence, serene contentment, and a warm emotional attitude toward others. The individual, so drugged, is willing to discuss the most intimate matters and seems incapable of refusing to answer questions. His state of mind is such that it is easy for the psychiatrist to get at the source of his trouble. We are not informed whether the drug also makes a person easily open to suggestion.

Ramie Fiber

ONE of the most persistently recurring of current fables is that ramie fiber (also known as rhea or china-grass) is on the verge of revolutionizing the textile industry. Once or twice every year someone announces that a new process of decortication or treatment of ramie fiber has been discovered which places it in a competitive position with cotton, flax, and other important fibers now in use.

A careful examination of the facts demonstrates how fabulous most of these contentions really are. Matthews, in his "Textile Fibers" (page 785), sums up the case of ramie admirably when he says: "Though ramie has many excellent qualities to recommend it as a textile fiber for definite uses, nevertheless, it lacks the elasticity of wool and silk and the flexibility of cotton. As a result, it yields harsher fabric, which has not the softness of cotton. Owing to its smooth and regular surface, it is difficult to spin to fine counts, as the fibers lack cohesion and will not adhere well to each other. The ramie fiber also resists the action of chemicals perhaps better than any other vegetable fiber; it has a high luster, being more glossy than jute; it is also firmer in quality than hemp. The specific gravity of ramie yarn is less than that of linen in about the ratio of six to ten; on the other hand, ramie yarn is denser than cotton in the ratio of about six to five.

"One of the principal uses of the ramie fiber at present is for making yarns used in the manufacture of gas mantle fabric, for which it is the most suitable material yet found, giving stronger and more resilient mantles than any other material. . . . It has been suggested as a substitute for linen, but as cloth made from ramie tends to crack when folded, it would not be a suitable substitute in linen collars and cuffs, and it is also doubtful if it would wear well in tablecloths or similar articles."

The porosity of ramie fabrics, a result of the smoothness and straightness of the fiber, received recently a somewhat costly demonstration when it was made up into sails for a racing yacht. It was found that the wind blew blithely through the ramie sail cloth, and the experimenters ended by dumping it into the sea. Its extreme brittleness (nearly equal to asbestos) was demonstrated with considerable embarrassment by a

Keystone

Streamlined car constructed by Captain J. V. Martin, airplane manufacturer. It is four passenger, has an overall length of 126 inches, a wheel base of 61 inches, a reputed top speed of 110 miles and a gasoline consumption of 45 miles to the gallon

man who ventured out in trousers made of the material. An examination of the internal structure of ramie fiber has been made in the textile microscopy laboratory here at M. I. T. by Professor E. R. Schwarz, which reveals why the fiber presents these difficulties. A longitudinal view of the fiber taken by polarized light shows the presence of internal breaks in the fiber structure which undoubtedly account for some of the characteristics listed above. A cross-sectional view shows pronounced internal fissures. The fibers are usually about 80 microns in diameter, about four times the average diameter of cotton fiber.

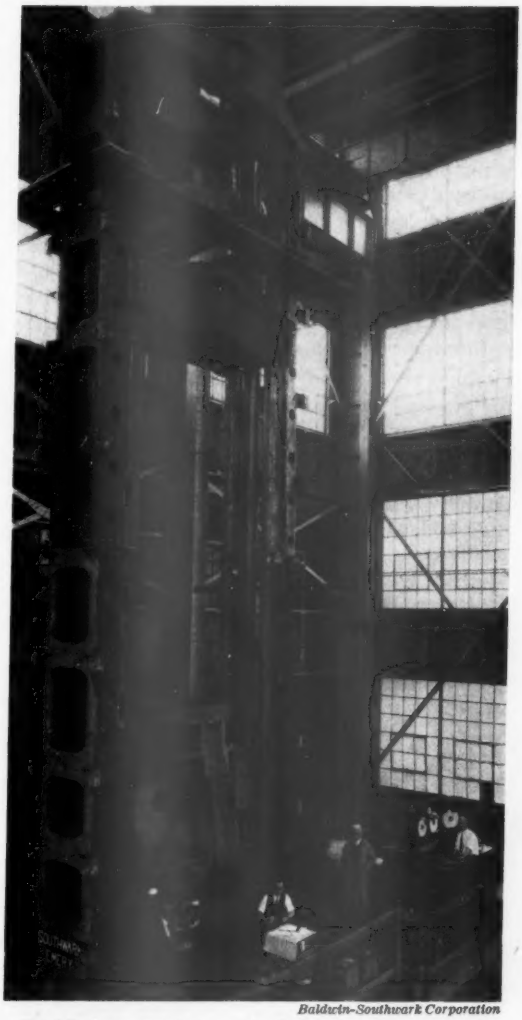
Ultraviolet Reflector

IT has been demonstrated that aluminum, with the proper surface treatment, reflects ultraviolet light better than any other metal. Thus is another and highly useful quality ascribed to this admirable metal, the attributes of which already are so profitably varied.

The proper way to treat the surface of aluminum to give it the best reflecting characteristics has been the subject of investigations carried on by the General Electric Lighting Research Laboratory and the Aluminum Company of America. This research has shown that the best reflecting surfaces are produced on pure aluminum and on sheet of commercial purity designated as 2S. An etched or "frosted" finish increases the reflectivity for both visible and ultraviolet light, and so it has been found expedient to determine the best way to etch for maximum reflectivity. Etching with sodium hydroxide and sodium fluoride followed by nitric acid has been found effective as well as treatment with hydrofluoric and nitric acids.

The use of this treated aluminum is bound to become widespread if the most efficient use is to be made of ultraviolet radiation. Many materials which transmit or reflect visible light efficiently absorb a large portion of the biologically effective ultraviolet.

Nature used commendable foresight in choosing aluminum as the best metal for reflecting ultraviolet. It is conveniently adaptable for use in lighting fixtures, being light, easily worked, and affording excellent opportunities for ornamental treatment. Furthermore it retains its reflecting luster tenaciously.



Baldwin-Southwark Corporation

World's largest testing machine built for the University of California. It is able to test columns up to 33' 6" long in compression and up to 4,000,000 lbs. load. In tension it accepts specimens up to 33' 6" diminished by machine stroke and will apply loads up to 3,000,000 lbs.

Aluminum Foil Insulation

IN yet another field aluminum scores a bull's-eye. When polished brightly the metal reflects about 95% of the radiant heat falling upon its surface and it retains this high heat reflectivity after long exposure to the atmosphere even at high temperatures.

For insulation purposes it is used in the form of foil, approximately .0003 inches in thickness. Layers of this foil with air spaces between ("Alfol" is the trade name of this type of insulation) are applied over the surface to be insulated. Generally, crumpled foil is used, which provides its own spaces with a minimum of contacts.

The insulation value of air spaces bounded by bright metallic surfaces was suggested as early as 1850 by Peclet, but the idea was not followed up because the metals employed, such as copper, silver, and tin, tarnished and were too heavy. Aluminum, however, is ideal, a fact originally recognized in Germany and lately demonstrated by Professor Gordon B. Wilkes, '11, in a long series of experiments at M. I. T.

Among its advantages over other forms of insulation may be listed the following:

LIGHTNESS. A cubic foot of aluminum foil insulation weighs three ounces as compared with ten pounds for cork and 17 pounds for magnesia. The French liner, *L'Atlantique*, is using about four tons of Alfol insulation on equipment which would have required 380 tons of cork and magnesia to give equal insulating efficiency. The United States Navy is specifying it for new vessels.

THERMAL EFFICIENCY. Exponents of the new insulation present data which indicate that crumpled foil is at least equal to cork at low temperatures and is even better than magnesia at high temperatures.

LOW HEAT STORAGE. Alfol is advantageously used on equipment which is intermittently operated because it saves time in permitting the desired temperature to be

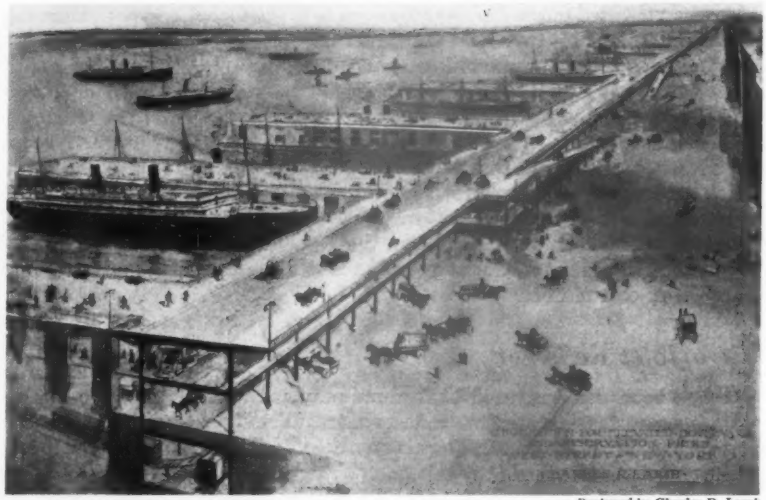
obtained and eliminates energy losses occurring in heating up and cooling off. Many bake ovens in Germany use aluminum foil insulation for this reason.

STRENGTH. The foil is vermin proof, is resistant to most industrial fumes and vapors, and melts above 1,200° F. It will withstand vibration to a remarkable degree, a factor increasing its value for use on board ships, in railway cars, and in trucks. The thin metal foil will support more than a mile of its own weight.

IMPERMEABILITY. It is impermeable to moisture and, should condensation occur on the outer layers, it is not retained.

From these qualities, it is evident that aluminum foil has widespread uses which include insulation of pipe lines, tank cars, household refrigerators, refrigerator cars, ships, water and oil tanks, and refrigerated rooms of meat and fish industries. Modern houses built in Germany have outer walls of copper and sheet steel with two inches of Alfol insulation. Among its disadvantages may be mentioned the necessity of encasing it with metal or other material. It will not stand alone as will cork, for instance. The surface of the foil must be kept bright.

The fact that a shining surface impedes radiation loss may be a justification of grandmothers who insisted upon burnishing the outsides of their cooking pots.



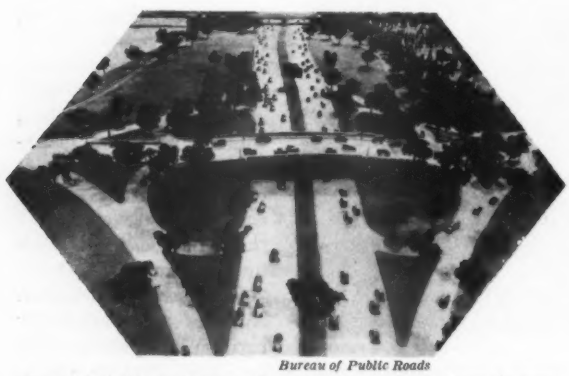
Designed by Charles R. Lamb

Suggestion for elevated roadways in New York to which are connected observation platforms constructed over the roofs of the river piers

Zirconium in Gems and Steel

THE fact that the United States is dependent upon foreign sources for the great quantities of manganese used in making steels, indicates the importance of a new steel in which the mineral zirconium is employed as a substitute for manganese.

Although manganese is found in North America, it is not available commercially and could be produced only at great expense. The world's present sources, according to Dr. George B. Waterhouse of the Department of Mining and Metallurgy, are the mines of Southern Russia, Brazil, and Africa, where it is found on the Gold Coast and more recently in South Africa. Cuba also has deposits of the mineral, and in the future may become an important source of supply.



Bureau of Public Roads

A model of the grade separation plan at the point where the new Mt. Vernon highway is to intersect U. S. Highway No. 1, Washington. The system of ramps will permit the distribution of traffic at all directions without left turns or cross traffic

Manganese is used as a deoxidizing agent and gives strength and toughness to the steels in which it is incorporated. It enters into all ordinary steels. Manganese steels are used in making various parts of automobiles, particularly axles and springs, and for special bolts, steam valves, armor-piercing shells, gun tubes, and many other products.

In investigations carried on at the United States Arsenal at Watertown, Mass., it was found that zirconium could be satisfactorily employed as a substitute for manganese in the manufacture of large steel castings for cannon. Another important development in this field is the work of the research staff of the Union Carbide and Carbon Research Laboratories in zirconium alloys.

Zirconium was first identified in zircon, a mineral composed of zirconium silicates, and in some varieties is used for gems. This mineral, Number 40 in the periodic table of elements, was first isolated by J. S. Berzelius in 1824. Zirconium is an ordinary constituent of many rocks, and the commercially important zirconium minerals are zirconia and zirkelite, found in great quantities in Brazil, and zircon, which is mined in Colorado.

The form of zircon used as a gem stone is found in Ceylon, Siam, and New South Wales. It occurs in colors of brown, orange, red, yellow, green, and blue. The "Matura diamonds" of Ceylon are zircons which have been artificially decolorized. When heated, some of these stones glow with an orange incandescence, while others, when ground on a copper wheel with diamond dust, emit a yellow glow.

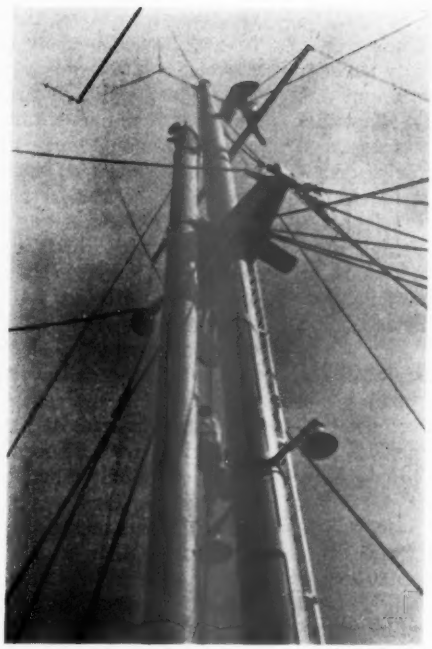
Zircon of the gem stone variety is sometimes called the "noble" or "precious zircon." The red and orange stones bear the names hyacinth and jacinth, and

the latter is mentioned in the Bible. The colorless, transparent pieces are known in the Far East as "jargoons."

Chemistry Since 1891

IN a paper recently delivered before a private group, Salmon W. Wilder, Chairman of the Board of the Merrimac Chemical Company, gave an excellent survey of the development of chemical engineering in the United States.

His career as a chemist and an executive has run concurrently with the development of chemical engineering. He received his degree from the Institute in 1891 with the first small group of chemical engineers to be graduated in this country.



Joseph Dauber

"In 1891," said Mr. Wilder, "chemistry was already an important course at Technology. For 20 years or more great progress had been made in industrial chemistry, and at the time of our graduation, the opinion was often expressed that a rate of progress such as had taken place during the previous years could hardly be expected to continue.

"Now, however, it is easy to look back and realize that in 1891 we had merely scratched the surface so far as chemical development is concerned, and what is true of chemistry applies in a measure to all branches of scientific work. . . .

"Even then, however, many executives of the old school, practical men, thoroughly trained and of sound judgment, began to realize that chemists and scientifically trained men were not always theorists, and if kept in their proper places and not given too free a hand, might be, and oftentimes were, really worth while; nevertheless, in concerns whose staffs boasted a chemist, it was often difficult for the latter to convince the management of his company that a chemist could effect savings, not only in processes of manufacture, but also in the purchase of raw materials. It was no small task for him to induce the proper executives to make purchases based upon specifications, rather than some trade name; in fact, one job for the chemist or chemical engineer was to 'sell himself' to his associates. . . .

"I have mentioned that 40 years ago chemistry, as an essential science, was firmly established in this country, and at Technology our course of instruction was comprehensive and thorough; nevertheless, it was recognized that in the domain of chemistry, both theoretical and applied, leadership was to be found abroad, and students seeking a graduate course or a doctor's degree as a rule entered one of the German, or possibly Swiss, universities or technical schools.

"There was, of course, a reason for Germany's commanding position, and you are all aware of the fact that although aniline dyes were discovered by Perkin in England, the development of their manufacture and the establishment of a real organic chemical industry took place in Germany. Moreover, the Germans, early grasping the importance of this new industry, bent every effort to the training of youth in their universities, so that the chemical and other industries requiring men with a fundamental knowledge of chemistry, should not lack for good material.

"The above facts are well known, but I do not think it is quite so fully recognized that chemical engineering is really an American institution, and in fact, our own M. I. T. may claim the credit for creating such a course, one that today is acknowledged to be of ranking importance in our scientific curriculum.

"I recall clearly that during my senior year, Dr. Lunge, who was then head of the Department of Industrial Chemistry in the Federal Polytechnic at Zürich, Switzerland, visited this country and spent some time at Technology. Dr. Lunge was recognized as the foremost authority on sulphuric acid, and the great Swiss Polytechnic attracted students from all parts of the world. After a careful investigation of our course in chemical engineering, he was so impressed by the character of the work required that in the following year he was willing to accept one of our students as a candidate for a doctor's degree at Zürich, and without the customary examinations. This, I believe, was a most unusual, if not unique, instance at that time.

"Ten years later I happened to visit Dr. Lunge at Zürich, and in the course of conversation he recalled his Boston visit and told me, with a good deal of enthusiasm, that one of the most fruitful results of his trip to our country in 1891 was the opportunity to study the newly established course in chemical engineering, the essential features of which had been adopted in a similar course at the Federal Polytechnic. Here is one instance, at any rate, in which M. I. T. took the lead, and at a time when foreign universities were, as a rule, recognized as being much farther advanced in every branch of science, both theoretical and applied, than those in our own country.

"During the decade ending about 1900, so far as economic development along scientific lines is concerned, this country was passing through a transition period. In many industries, established processes were adhered to regardless of their unscientific character. This is not altogether surprising, for one can readily appreciate the reluctance of a manager or superintendent to switch from a thoroughly understood process to an untried one. As an example, let us consider leather. Many of the formulas and methods employed in tanneries had been in use for decades; the final products were known to be absolutely dependable, not alone in appearance, but

in every essential quality, such, for instance, as strength and extreme durability. With a new process, however, a few shipments of finished material, apparently perfect, but which later on proved to be defective, might not only result in direct claims, but seriously affect the maker's reputation and jeopardize future business.

"With the Twentieth Century, our economic and industrial life entered upon a new era, that of electric power transmission and the long-distance telephone, of the automobile and electrochemistry, of high pressures and temperatures. A new structure was being framed, the foundations of which were laid, in part, at any rate, by the biologist, chemist, physicist, and electrical engineer. . . .

"During the year 1914, but prior to the outbreak of the War, business was at a low ebb, competition keen, and overproduction evident in many lines. The chemical industry was no exception to the general rule, and for some time potential capacity had been greater than actual consumption requirements. This had served to check new construction and plant extension. With the advent of war, however, the scene shifted. I will not attempt to outline the changes that were brought about in the chemical industry, but it soon became evident that the chemist must play an all-important part in the War, and indeed that, in a large measure, the maintenance of our industrial integrity depended upon our chemical manufacturers. Very soon the shortage of dyes and other organic products became acute, and in an endeavor to cope with this condition, our chemical works were taxed to the limit. Never had there been such a demand for chemists and skilled technical men.

"Following the sudden and tremendous demand for dyes and pharmaceuticals, came an even more imperative one for high explosives and the intermediates employed in their manufacture. The truth of the matter is that not only our own economic salvation, but the outcome of the war depended upon the ability of American chemists to meet this critical situation.

"Finally, in 1917, we ourselves were drawn into the conflict and in due course practically the entire output of American chemical works was employed, directly and indirectly, either in the manufacture of explosives and munitions, or those materials essential to the conduct of the War. I wish that I could give you a word picture of some of our own experiences during this critical period, but space is limited.

"As a result of the situation just outlined, a new chemical industry sprang into being and existing works were largely expanded. Many new plants were built, some of them for purely governmental purposes. Scores of millions of dollars were invested in buildings and equipment, much of which was designed to meet emergency requirements. During the War the slogan was 'Production,' and very often economy and efficiency were sacrificed in order to secure output. Selling prices became matters of secondary importance and in many cases products were commandeered by the Government.

"Looking back, it is difficult to realize the conditions existing in the chemical industry shortly after our entrance into the War. All honor to the men, and women, too, who were 'over there,' but the strain was terrific here at home for those engaged in the manufacture of chemicals. There was a period of about two years when the major portion of the output of my own company's plants was required, not only in the making of explosives, but in nearly every branch of industry, and knowledge of the fact that any catastrophe at our works would result in the almost complete closing down of New England industries was a responsibility that one could never lay aside. Thus it came about that when the Armistice was signed, the chemical industry found itself in an extraordinary position. For example, the annual output of sulphuric acid — the most important of all chemical products — had increased from approximately 4,000,000 to more than 9,000,000 tons, and huge stocks of acids and other chemicals used in the manufacture of munitions were on hand and in process. For a time, conditions were demoralized and the market values of many commodities dropped to levels far below the cost of production. This was followed by a period of intense activity, and then came one of reconstruction and adjustment; labor was scarce and wages high — very different from the situation that now prevails. Then, too, industry was out of balance; in the case of some commodities a surplus existed, whereas in others there was an actual shortage. Lack of knowledge, or judgment, as to the real situation, together with wildcat development in some lines of production were in part responsible for this state of affairs. Exaggerated ideas as to the possibilities in chemical development were readily accepted by thoughtless investors, and many abandoned plants bear witness to this fact. On the whole, however, we may survey with pride the results accomplished by American chemists and chemical engineers during and since the War, and I do not know of any better evidence that could be presented than the fact that today this country is entirely independent so far as chemical products are concerned. This statement applies to organic, as well as inorganic, chemicals, and it is a satisfaction to know that American manufacturers now supply more than 90% of the country's entire requirements of dyestuffs, pharmaceuticals, photographic and fine chemicals. . . .

"Without doubt we are now in the midst of a depression greater, at any rate, than any that have occurred during my business career, and furthermore, the condition is not a local one, but world-wide; nevertheless, chemists and chemical engineers are pushing their research work more vigorously than ever, and this alone gives us reason to believe that the outlook for further advance in civilization and future prosperity was never brighter than at the present time. In less than 15 years, the initiative in scientific research has passed, in considerable measure, from Germany to this country, and this is a fact of far-reaching significance.

"As a result of applied chemical research, a few essential raw materials are now made to yield a host of useful products, and from the many developments of recent years, the following examples will serve to illustrate what I have in mind:

"Take cellulose, for example, either cotton or wood. From this, as a raw material, are derived the Duco type of lacquers that very largely have taken the place

of paints and varnishes. This is an American development that has spread throughout the world. From the same materials we also make rayon, celanese, and cellophane — the latter a distinctly American product.

"From petroleum and natural gas we are now able to produce a long line of synthetic products, such, for example, as Prestone (ethylene glycol), various alcohols, including the familiar ethyl alcohol, which is at once so useful and yet the cause of much distress and suffering.

"With new high-pressure methods of treatment, gasoline yields have been increased twofold, and furthermore, research has proved that a few drops of a virtually unknown compound, when added to a gallon of gasoline, entirely changes its characteristics, and today tetraethyl lead makes possible the design of an engine smoother in operation and with greater fuel mileage than ever before.

"With coal and air as raw materials, and with processes operating at high pressures, we are now making ammonia, nitric acid, and fertilizer materials.

"In metallurgy, the use of corrosion-resisting materials is revolutionizing industrial and building operations, and a conspicuous illustration is found in the development of chromium plating, an American contribution to the art of electroplating.

"In the rubber industry, chemical accelerators and retarders have revolutionized vulcanization processes and made possible products of a quality never dreamed of before. In tire consumption alone, researches of the past decade have saved automobile users millions of dollars and eliminated much of the difficulty in operating pneumatic tires.

"New drugs and new anæsthetics are among the contributions to the field of medicine and surgery; sunfast and laundry-proof dyes are now available for every type of textile product, and so on down a list which could be extended indefinitely.

"This is an age of progress, in which 'the glory of the heavens is being disclosed, and the structure of the atom and the molecule laid bare.' Mindful of these blessings, and with ever-increasing knowledge, we may face the future with confidence and the assurance of revelations to come that are beyond the scope of our imagination."

New Cure For Rickets

THE development of a new cure for rickets by means of synthetic, organic peroxides was announced on February 14 by Professor John W. M. Bunker at a Society of Arts popular science lecture.

These new compounds, which can be prepared in any laboratory and from a variety of chemicals, were the result of joint research by Professor Bunker and Robert S. Harris, '28, both of the Institute's Department of Biology and Public Health, and Dr. Nicholas A. Milas, of the Research Laboratory of Organic Chemistry.

These antirachitic and synthetic substances are entirely different from cod liver oil, containing no oils at all, and they have no relation to ultraviolet light. They are compounds which have in common a particular chemical grouping of oxygen which is believed to be the secret of their power to cure rickets.

TRANSATLANTIC

By the River Cam

HORA Novissima, Tempora Pessima. The economic world is doing its best to emulate the expanding universe now so much in fashion among the astronomers, and to blow up. In plain language, the period of depression on which we are now entering is getting more firmly entrenched every day, and there are no signs of any attack competent to dislodge it.

In England the situation is not too bad. There is still a great deal of accumulated wealth available for emergency purposes, and on the other hand there has been enough adversity since the War to cause the people to look economic facts in the face, and to take measures, such as the dole, which are disagreeable but necessary. Czechoslovakia is making a fair go of it under French patronage. In Germany, and to a lesser extent in Austria, the situation appears in all its stark hopelessness. The inflation period of 1922–24 bled the middle class white, and Germany is facing the depression without reserves. The country is economically dead on its feet. The people are divided into the declared bankrupt, and those who are insolvent, but not yet petitioned into bankruptcy, owing to the futility of trying to collect money where there is no money. The country may go Hitlerite without any belief in Hitler, or Communist without any faith in Communism, simply out of pure despair. Anyone with the slightest sense for facts realizes that the reparations are dead, and with them the war debts, that we never can collect another cent from Europe, and that it will simply add to the universal depression and hopelessness if we try. Remitting the debts and reparations will be very far from bringing immediate prosperity; collecting them or trying to collect them will bring bottomless chaos.

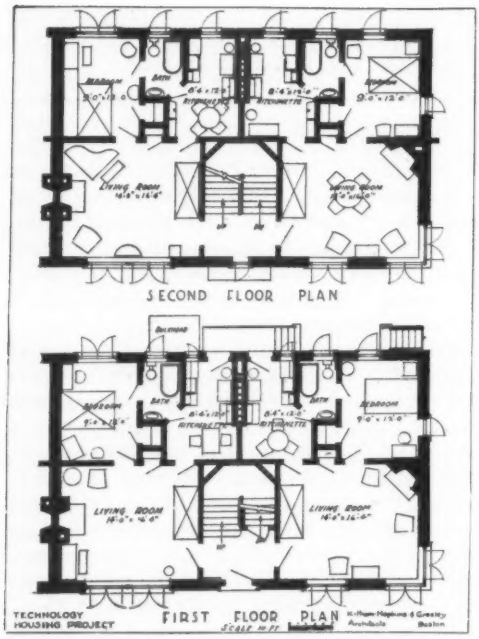
The most surprising thing about the whole business is the appalling ignorance in each country of the state of affairs in all the others. The Englishman has but the most shadowy idea of the German depression; the German is utterly at a loss to understand the Englishman; the American is chiefly interested in crawling into a hole and pulling the hole in after him; and the Frenchman knows and cares nothing about any of the rest. Meanwhile the economic entropy keeps increasing.

I have lectured at Prague, Leipzig, and Berlin. The lecture at Prague was at the German University, but the Czechs came around to the talk, though they did not stay for the Nachsitzung at a café. The split of the intellectual life into two camps that do not approach closer than a somewhat stiff neutrality is ruinous. The Germans form almost a quarter of the population of the country, but in Prague, where they have their university, they represent only a twentieth of the population. Thus the German university is to a certain extent exotic, while the Czech university is hampered by not being able to draw on some of the best talent in the country. The mathematics and physics people at neither university are chauvinistic, but the work cannot help suffering from the general situation. (*Continued on page 267*)

HOUSING MARRIED

A Proposal to Provide Inexpensive

THE lack of any convenient and coördinated arrangement for the housing of the instructing staff is well recognized as a handicap to effective work and to the maintenance of that esprit de corps *essential to enthusiastic coöperative effort. In fact, the lack of convenient, moderate-priced housing facilities offers a really serious obstacle to securing the services of younger members of the staff. For these reasons, the adoption of some such plan as that*



Layout of apartments in proposed housing development

RECOGNIZING the recent definite trend toward a larger group of graduate students at M. I. T., and the living problems of some of the instructing staff, a number of Alumni have become interested in the possibilities of better housing for these groups.*

The short terms of residence, which are the rule with graduate students, render social adjustment and general living conditions particularly difficult, especially if the students are married and possibly have young children. Whereas this problem is difficult no matter where a school may be located, it is particularly difficult at the Institute. The present housing facilities are limited to a few apartments on Memorial Drive with no further opportunities until the industrial belt of Cambridge is traversed, which brings one practically to Harvard Square, where facilities are largely absorbed by Harvard University.

Housing facilities on the Boston side of the Charles River, while perhaps ample, are expensive and often beyond the means of the graduate student or instructor. The vacant land on the westerly side of Massachusetts Avenue now owned by the Institute, some of which faces directly on Memorial Drive, presents a desirable site for a housing development.

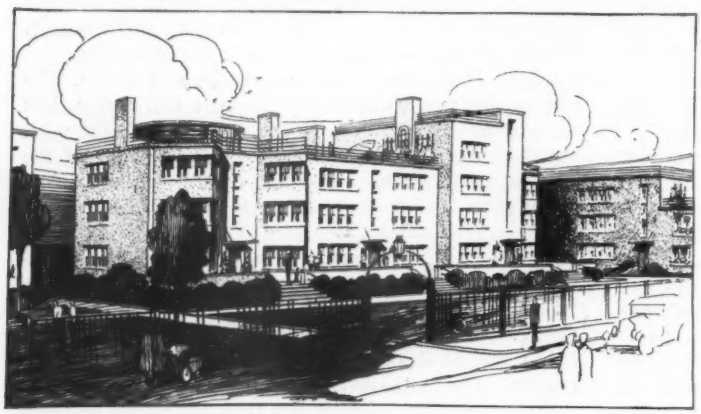
Of course, it is likely and altogether desirable that plans for permanent buildings on this site will be visualized at an early date; but it is probable that buildings on the waterfront may be the last to be constructed, since they would undoubtedly be the most permanent and monumental of the group. On the other hand, the present trend of construction on land fronting on Memorial Drive and not owned by the Institute is of a semi-permanent nature and points to the possibility of utilizing this land in the meantime for residential purposes.

It is with this thought in mind that a group of M. I. T. Alumni have been considering in some detail the possibility of erecting apartments on a portion of the waterfront land owned by the Institute, having in mind that over a period of 25 or 50 years, these residential buildings will be replaced by more monumental, educational buildings.

In view of the possible limited life of the buildings outlined above, the construction methods must be as economical as possible. Nevertheless, the present trend in building construction indicates that such a group as is contemplated for this development can be built of fireproof construction at a very reasonable figure. In fact, consideration of insurance rates, safety features, and maintenance charges for a life of 25 to 50 years indicates that the slight additional expense of first-class construction is more than warranted.

Again, any buildings which might be erected on this site under the auspices of the Institute or its Alumni should be of the most up-to-date and useful apartment house construction. The adaptability of modern architectural expression to fireproof construction is also another potent argument for building better than the usual tendency of speculative builders, wherein there is

* This article is sponsored by a group of interested Alumni, including Walter H. Kilham, '89; George L. Gilmore, '90; Merton L. Emerson, '04; and H. Whittemore Brown, '15. Mr. Kilham's office (Kilham, Hopkins and Greeley) executed the drawings.



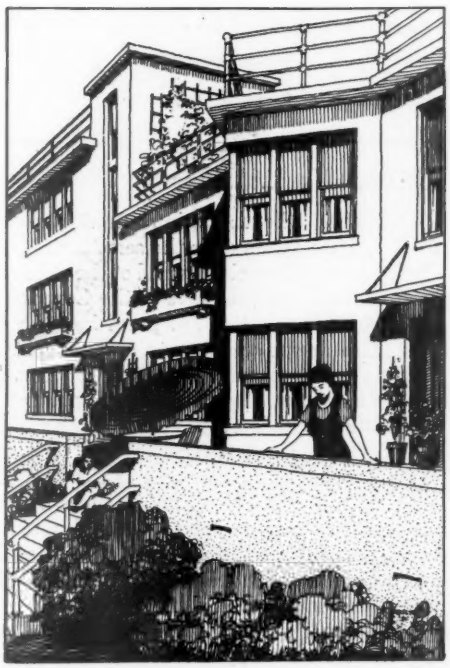
A view in central court in housing project

GRADUATE STUDENTS

Apartments for Their Families

described in the following article would be of definite benefit to the Institute. While the Institute does not have funds available for the financing of this housing plan, the Executive Committee will consider the possibility of assisting in its realization through a lease of suitable vacant land for a period of years if sufficient support can be obtained for the plan.

KARL T. COMPTON



Terrace on the front side

little attempt to make the appearance anything but extremely cheap and ordinary. Modern architecture enables the architect to design a very attractive group of apartments three stories in height, together with some two stories and some four for proper group effect, together with solariums and roof gardens, which would be useful supplements to the accommodations of the apartments themselves through the possibilities of nursery schools, play rooms, and the like.

The proposed site facing Memorial Drive is ideal for this purpose and it is possible to give all apartments a view over the river, together with ample light and air on the other sides. There is also sufficient room for lawn and play space around the group.

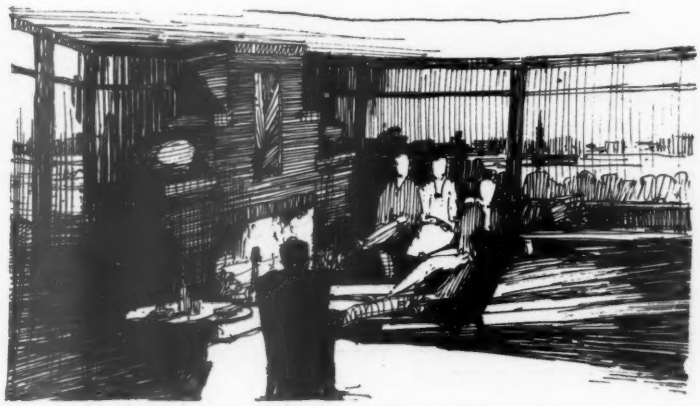
A study of the accommodations for apartments for graduate students seems to indicate that a majority prefer limited accommodations at a very reasonable cost, which can be best provided in the combination of a good-sized living room with a small bedroom and combined kitchenette and dining alcove. This plan was the most generally acceptable of those used by the Harvard Housing Trust, where conditions were somewhat similar.

The accompanying plans indicate in a general way the scheme which is under consideration. It will be noted that the living room which is 14 x 16 feet, with large windows taking advantage of the excellent view, contains a fireplace, coat closet, and plenty of room for a davenport, small grand piano, chairs and tables. The bedroom and bath make a practical unit, and are provided with good closet space. The kitchenette, arranged with gas stove, automatic refrigeration, and ample cabinet space on either wall, together with the adjacent dining alcove, provide a desirable unit for this phase of housekeeping. It is also interesting to note that by virtue of the passage through the bath, it is possible to go from the kitchen to the bedroom without passing through the living room, a point which will be much appreciated by the housewife.

Heat, hot water, and electricity are amply provided for by central plants in this group or from the Institute power plant, providing economies in those large items of operating expense.

Provision is also contemplated for a number of garages.

Through economies in construction, financing, maintenance, and operation, it is believed that it is entirely feasible to construct these apartments and rent them to graduate students and young married instructors at a figure considerably lower than would be possible under private ownership and operation. A recent survey indicates that a large number exist among this group who would be interested in the project. Whereas it is difficult to foresee conditions at the Institute 25 or 50 years hence, it is quite evident that the present trend toward graduate education is increasing rather than decreasing, so that the problem of proper accommodations for this group of men and their families would seem to be one of increasing importance and one that warrants careful consideration on the part of the Institute authorities and the Alumni in general who are interested in the progress of the Institute.



Fireplace in solarium; a commons room on the roof

THE INSTITUTE GAZETTE

Alumni Nominations

ONE of the most important functions of the Alumni Council is the selection of officers of the Alumni Association and of the slate of candidates from which Term Members of the Corporation may be selected. By constitutional provision, the Council entrusts this important duty to one of its standing committees, the Committee on Nominations. This group of nine men annually submits to the Alumni body one candidate for each Alumni Association office and, in recent years, three candidates for each of the three vacancies that annually occur in the Corporation.

As Alumni are aware, an extended study has been under way of various phases of the Alumni Association's work, particularly that of Term Membership selection, and a questionnaire soliciting the opinion of all Alumni was distributed last summer to furnish data for this study. It was, therefore, appropriate when the Nominating Committee this year began its deliberations that it give heed to the results of this questionnaire. This it did, with the result that the following recommendation was prepared and submitted to the Council and was unanimously accepted by that body:

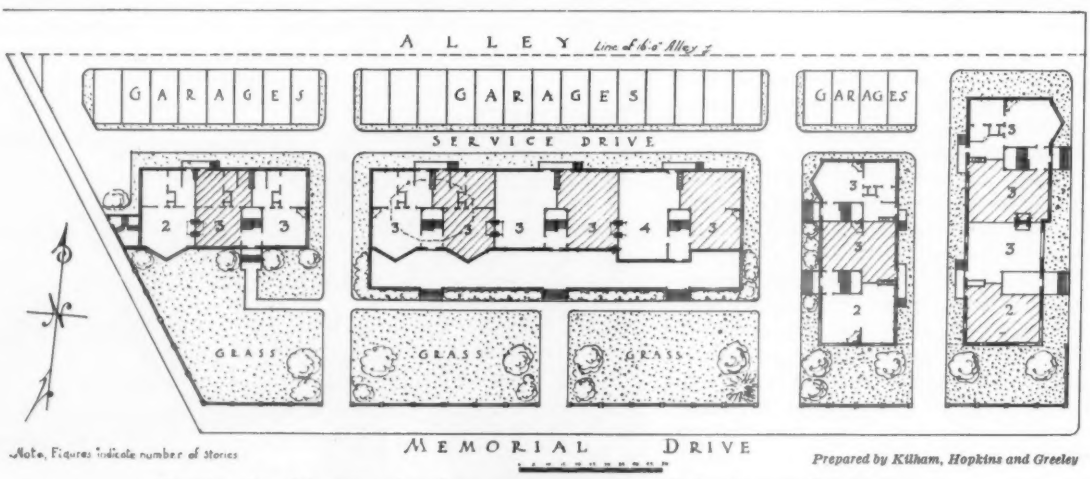
"WHEREAS it is evident from the report on the recent expression of Alumni opinion that it is the desire of Alumni that the number of candidates for Term Membership on the Institute Corporation as submitted to them for nomination should be reduced to three, and since this wish can be fulfilled under the present By-Laws by a vote of the Council to replace previous votes concerning nomination of Term Members.

"BE IT RESOLVED: That in submitting names to the Alumni for nomination for Term Membership on the Institute Corporation the Nominating Committee of the Alumni Association be instructed in accordance with the By-Laws of the Association to nominate at least one candidate for each vacancy and until it is otherwise voted, to limit the number to one candidate, and further that previous votes contrary to this resolution be and hereby are revoked."

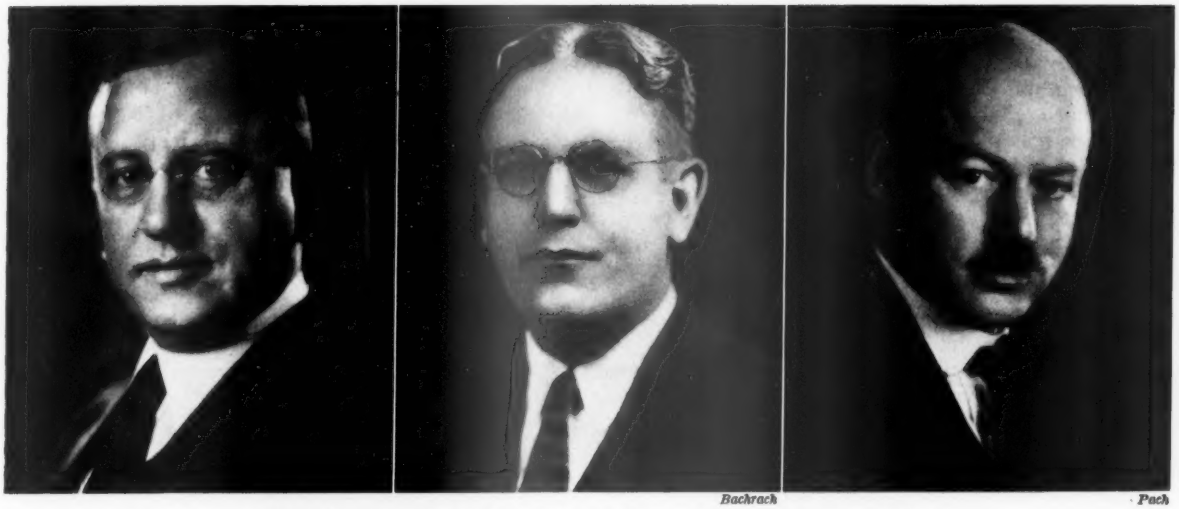
The acceptance of this recommendation left the Committee with the responsibility of nominating the three men who will fill the three vacancies that will occur on the Corporation when Messrs. William Z. Ripley, '90, Elisha Lee, '92, and Roger W. Babson, '98, conclude their five-year terms on June 30.

After considering several hundred names, the Committee unanimously nominated M. Herbert Eisenhart, '07, Vice-President of the Bausch and Lomb Optical Company of Rochester, N. Y.; Bradley Dewey, '09, President of the Dewey and Almy Chemical Company of Cambridge and for the current year President of the Alumni Association; and Jerome C. Hunsaker, '12, who established Technology's first subjects in aeronautical engineering and is now Vice-President of the Goodyear-Zeppelin Corporation of New York and Akron. When the ballot is mailed out to Alumni in March, these three names will be presented for the ratification of the Alumni electorate, and then in turn presented to the Corporation for formal election, that body invariably accepting the nominations of the Alumni Association.

On the same ballot will be included the other nominations made by the Committee on Nominations and approved by the Alumni Council. Chief among these is Allan W. Rowe, '01, to succeed Bradley Dewey, '09, as President of the Alumni Association. Dr. Rowe is Chief of Research at the Evans Memorial of the Massachusetts Memorial Hospitals and Professor of Physiological Chemistry in the Boston University



Tentative plan of the proposed graduate apartment group described on the preceding two pages



Bachrach Pach

NOMINATED FOR TERM MEMBERSHIP ON THE CORPORATION
From Left to Right: M. Herbert Eisenhart, '07; Bradley Dewey, '09; and Jerome C. Hunsaker, '12

School of Medicine. He is Secretary of his Class and for many years has been a member of the Advisory Council on Athletics and its Secretary-Treasurer since the retirement of the late Major Frank H. Briggs, '81. In this latter group, he has been the patron saint of Technology's undergraduate athletics, and in their behalf he has worked unflaggingly and to their great advantage.

In Alumni Association affairs, he has participated perhaps to a greater extent than almost any other Technology alumnus. He is a former member of the Executive Committee and at the present time a member of the Committee on Assemblies, on Housing Undergraduate Publications, on Audit and Budget, on Nominations for Advisory Councils, and on Alumni Association Reorganization. To pile Pelion on Ossa, he is also a member of the Alumni Advisory Council on the Boathouse.

To be Vice-President of the Alumni Association for two years, the Nominating Committee selected Harrison P. Eddy, Jr., '17, partner of Metcalf and Eddy, Boston; and to serve on the Executive Committee for two years, Marshall B. Dalton, '15, Vice-President of the Liberty Mutual Insurance Company, Boston; and Charles A. Sawyer, Jr., '02, President of the Sawyer Construction Company, Boston. As representatives at large in the Alumni Council, the Committee selected: Franklin B. Richards, '84, Clarence K. Reiman, '12, George T. Cottle, '98, Ralph H. Sweetser, '92, and Donald W. Southgate, '11.

To all of these nominees The Review extends felicitations and to the Nominating Committee congratulations for the excellence of its judgment in selecting so notable a slate for both the Corporation and the Alumni Association.

Bachrach

Dr. Allan W. Rowe, '01, sole nominee to the Presidency of the Alumni Association for the year 1932–33

Annual Alumni Dinner

IMPELLED by a warm fellowship and by a strong sense of loyalty to what might be better called their *almus pater*, graduates of M. I. T. instituted in 1876 the first Alumni Association Dinner. It was celebrated at Young's, and those of a total Alumni body of 122 who were present elected Robert H. Richards, '68, President of the Association. From then until now that initiatory dinner, with few exceptions, has been repeated yearly and elaborated with a zeal that has suffered no diminution. It has grown to be an outward manifestation of an inner unity between the Institute and its Alumni, an occasion for demonstrating and cultivating a productive interrelationship.

The 1932 dinner, celebrated on February 6 at the Hotel Statler, Boston, was a continuation of this spirit that has run so strongly since 1876. More than 300 Alumni and guests were present, of which about one-third were women. Preceding the dinner itself, a reception was held at which Alumni met administrative officials of the Institute, members of the Executive Committee of the Corporation, and officers of the Alumni Association.

After the dinner, there were two scientific demonstrations and two speeches, in addition to the presentation of honorary membership in the Association to Mrs. Ellen King and a formal accolade to Professor James R. Lambirth.

The first scientific item was in charge of Professor R. D. Bennett and B. E. Warren, '24, of the Department of Electrical Engineering and Physics, respectively, and it consisted of a demonstration of Geiger Counters. These instruments are remarkably sensitive when used as a detector of feeble light beams, of electrons, and of atoms — so sensitive, in fact, that they will register the entrance of the faintest beam of light, a single electron, or a single atom. The counter is essentially a metal vacuum tube, containing a fine wire at the center with a potential difference of about 1,000 volts between the cylinder and the wire. Perhaps the most spectacular part of the demonstration was the loud clicks which were heard by the entire audience and which were produced by the mysterious cosmic rays which scientists are now trying so hard to explain. The second scientific experiment was that of the Van de Graaff 1,500,000-volt generator, which was described at length in The Review for December, 1931. The generator was operated and described by Professor Vannevar Bush, '16, and Mr. E. S. Lamar, Research Assistant to President Compton.

Between these two demonstrations, Dr. Rowe, nominee for President of the Alumni Association next year as announced on page 258, spoke on undergraduate activities. He named and briefly described the various organizations which are operated by students, described how Technology athletics are entirely under the management of undergraduates, and apotheosized the attitude at Technology which insists upon the students conducting their own affairs.

President Dewey, who, of course, presided at the dinner, at the beginning of his administration requested that Dr. Compton plan to present an address on the educational policy of the Institute at this dinner. This Dr. Compton did to the great satisfaction of all those who were present. His entire address is printed in this number of The Review, beginning on page 242.

After the dinner there was dancing.

Peregrinators

TO ANNUAL dinners of Technology clubs in Washington and New York and to regular and extraordinary meetings of Alumni groups in widely separated points such as Montreal, New Orleans, Portland, Maine, and Phoenix, Ariz., reported emissaries of the Institute during December, January, and February. A summation of these visitations suggests a winter of unusual endeavor to inform graduates and former students of the current state of Technology, of its recent past and future aims.

Last autumn Dr. James L. Tryon, Director of Admissions, was carrying out the two months' itinerary, (printed in the October Review) of calls upon university and secondary school officials in the Northwest and on the Pacific Coast. Early in December he traversed the Mohave, crossed the Colorado, to make stops at Phoenix, Tucson, El Paso, Roswell, Albuquerque, Santa Fe, and other Arizonan, Texan, and New Mexican points. Meanwhile, on December 3, the New York Alumni met concurrently with the American Society of Mechanical Engineers to hear from Professor E. F. Miller, '86, Head of the Department of Mechanical Engineering, Professor Charles E. Locke, '96, Secretary of the Alumni Association, and Major A. S. Smith, Superintendent of Buildings and Power. A week later they reconvened for a seminar (reported in the February Review) on various aspects of modern building construction. It was led by Professor R. F. Tucker, '92, Head of the Course in Building Construction, and his associates, Professor W. C. Voss and L. C. Peskin, '28. On December 15 the Montreal Alumni were addressed by Professor E. H. Schell, '12, Head of the Department of Business and Engineering Administration, and on the last Wednesday of 1931 the New Orleans Alumni had President Compton as their guest.

January 15 found Dr. Compton and Professor C. E. Locke, '96, Secretary of the Alumni Association, at Portland, Maine; on January 27 Professor S. C. Prescott, '94, former President of the Alumni Association, visited Cleveland.

Intermediate between the Portland and Detroit meetings came, on January 18, the annual dinner and dance of the Washington Society of the M. I. T., presided over by Professor H. W. Tyler, '84, former Head of the Department of Mathematics and present Secretary of the American Association of University Professors as well as consultant in science for the Library of Congress, and, on the following evening the annual banquet of the Technology Club of New York. At each of these affairs Bursar H. S. Ford, Registrar J. C. MacKinnon, '13, Professor L. F. Hamilton, '14, Chairman of the Dormitory Board, and Dean H. E. Lobdell, '17 — the so-called "Four Horsemen" — spoke, giving in substance the joint report on various phases of the Institute's administration that they first presented to the 154th Meeting of the Alumni Council. A digest of their remarks on the occasion appeared in The Review for last December.

At the New York dinner they were introduced by President Compton, after he had been presented by Richard H. Ranger, '11, President of the Club, who acted as toastmaster in the absence of Charles Hayden, '90. This dinner being the first held by the New York Alumni in the new Waldorf-Astoria, the diners were formally welcomed by Lucius Boomer and later in the evening the well-known Oscar added his greetings. Preceding the speaking, the diners were entertained by a demonstration of Mr. Ranger's pipeless organ, the tones being received over a special wire from his home in Newark. The dinner was also notable in that exactly the same number of guests (300+) were present as at the 1931 banquet and because those present witnessed a demonstration of the experimental 1,500,000-volt generator, developed by Dr. Robert J. Van de Graaff of the Institute's Department of Physics. Due to Dr. Van de Graaff's illness the apparatus was described and operated by Dr. Compton.

For February, C. Frank Allen, '72, was to visit Californian clubs and Frank L. Locke, '86, Personnel Director of the Division of Industrial Coöperation and Research, had appointments (*Continued on page 268*)

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HOUSES OF THE FUTURE

(*Continued from page 241*)

produce, of course, the same result, and apparently the final decision as to fuel will rest with the economic fates. Then the cellar can either be eliminated altogether or devoted to the purposes we have indicated earlier.

The possibility of central heating by a local plant is probably remote except in highly urban districts or in such newly built towns as Radburn or Becontree. New cities on old sites, such as those sketched by Le Corbusier, are fine things to read about but prohibitively costly to produce. Old towns probably cannot afford a central installation. Whatever the source of heat, the country is becoming humidity-conscious. The first development of washed and humidified air will undoubtedly come in the hot air system which has reduced its ducts to an area something less than that of the rest of the house. Steam and hot water systems seem to be on the way out, if humidity is really demanded, unless radical changes are made in their design. The ultimate development of this type of heating consists of the blowing of washed and watered air past individual heaters, presumably electric, placed in every room which will permit proper temperature control in each unit of living space according to the conditions imposed by the room's purpose. Modern thermostatic valves on each radiator will also permit this control. Any humidifying, however, demands double windows or no windows. Unfortunately, despite developments in lighting, which we shall next discuss, we are and will remain rank sentimentalists and are going to like to look outdoors. I am afraid we will have to keep windows as part of the general scheme.

Another type of heating that may or may not be successfully incorporated is that of panel radiation. Considerable experiment has been done on this subject in England and it is now beginning to attract American attention. Radiant panel heating relies on the use of panels set in the walls, or more often in the ceilings, in front of a source of heat, usually either hot water pipes or electric units. The walls may be kept at a temperature of not more than 80° and the room at certainly no more than 60° (50° is regarded as satisfactory in Great Britain). Everyone knows the comfort of radiant heat as given off by a fireplace, but the low temperatures permissible are not generally appreciated. The advantages of this form of heating are the known therapeutic value of radiant energy and the fact that with the permissible low temperature, a higher degree of relative humidity is obtained for the same absolute humidity. It is thus possible that panel heating may be either an adjunct of or a successor to all our present devices.

That is all except one. We are not going to brick up our hearths again. We are giving up a lot of things but that we are going to insist on, as long as there is a piece of furniture to burn. Houses will, of course, be refrigerated in the summer, although the cost at present is exorbitant, and insulated sufficiently to make such refrigeration and heating economically feasible.

Our lighting is as obsolete as it well can be. I dare say there is scarcely a lamp fixture in your house that is not designed as though it were (*Continued on page 264*)

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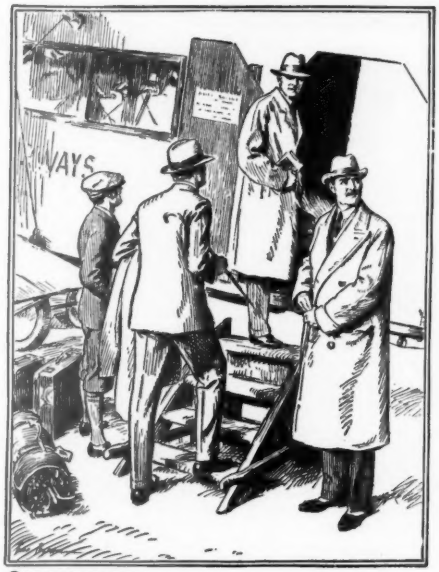

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HOUSES OF THE FUTURE

(*Continued from page 262*)

made to hold a candle. We are going to take gas-filled tubes and arrange them all around our rooms in rows of three or four at the cornice level and regulate intensity by the number of tubes we turn on. If we are very emotional, we can even suit the color of our lighting to our mood. Some of these tubes have shown therapeutic value and will help out our ultraviolet ray deficiency. The light will be uniform and diffused and cease straining our eyes. But nobody likes to read in Grand Central Station, and when a man is alone with his pipe and book he is going to need a lamp somewhere around and darkness elsewhere.

Perhaps we will go back to candles as our luxury lighting and use them socially other places than in the dining room. They have an atmosphere that we shall not want to give up. There will, of course, be no base plugs, but, instead, some sort of a strip that permits plugging in of any sort of electrical device anywhere. And ultraviolet windows will probably persist if they improve unless medical science decides that after all ultraviolet is not what we need.

Curiously enough we can do a lot about our sanitation. We can adequately ventilate our water closets. We can throw our rugs in the trash barrel. In the present day, rugs are just as unsanitary as were rushes and rosemary in the days of the Normans. A square inch of rug contains so many bacteria that we do not dare think about it. Good looking rugs, particularly orientals, belong on the walls, the rest can be thrown away. Synthetic cork, rubber, and resin products are less slippery, far cleaner, more durable and only need to have some real study given to their æsthetic expression which so far has been directed to copying tile or what not. When the makers realize they have a material that is intrinsically beautiful, we will gladly use their products on our floors.

Wall treatments will be simpler. Wall paper will be washable or disappear in favor of tinted, fairly smooth-textured plaster, perhaps pre-made. New and better paints will not discolor every time we spill water on them. Metal foil will be used for some finishes and sooner or later taste will tell and we will insist that metal look like metal and not like Circassian walnut; that asbestos cement both become and remain just that and not a cheap imitation of Carrara marble. Baseboards and corners will have to be rounded and undoubtedly moldings, windows, and door frames will be made of metal. The elimination of dust will be much easier and yet we need not have the sensation of living in a hospital.

Our bathrooms have, on the whole, advanced far but we have to do something soon about the slipperiness of our bath tubs which are 1,000 times as dangerous to life and limb per entry as railroad travel and 200 times as dangerous as going around in airplanes. The old tin tub was not so bad but there is possible some compromise between it and slithery porcelain. What we shall do about the color craze no one can predict. Simplicity of taste will in the end dominate because the rest of the house is going to be simple and restful.

The kitchen is the most modern room in the houses today and the best developed. Here chromium, green, white, and black may be used (*Concluded on page 265*)

HOUSES OF THE FUTURE

(*Concluded from page 264*)

rectangularly to fine advantage. We have yet to find a machine that combines the myriad offices of dish washers, mixers, laundry machines, and mangles into one, but no doubt that will come. We must make our stoves a lot cooler to work with if we do not want to degenerate further in our food sense. No woman is going to put up with the temperature much longer. Frosted foods already take much less time to cook than fresh ones, and the difference is not noticeable to a nation that does not garnish its diet and is less imaginative gastronomically than any other civilized group (not excluding the English even if they do take their sauces from a bottle). Canned soup does not taste like soup from the old kettle. Baker's bread is not as good as fresh home-baked bread. But we are used to these things and do not mind, and with domestic service on the wane, we may as well face the decadence of cooking with equanimity. It is entirely conceivable that we will have a calidator along with our refrigerator and that the grocery boy will bring hot meats every day packed in the hot equivalent of dry ice. Our eggs, canned soups, coffee, and other minor additions we can make on the little electric devices. But, we hope, the stove will be with us for quite a while yet if only it will be better insulated and ventilated. This can be done quite easily if the kitchen is regarded as a laboratory and the stove provided with a hood similar to that in use at good chemistry benches.

Our houses will have incinerators, less for garbage than for waste paper, the volume of which gets greater every year and threatens to engulf us in its tide as it did Anatole France's philosopher. The elimination of furnace units as we know them will make it imperative that we have chutes into which we can throw the packages and papers for combustion, because no good housewife will let the wood ashes of her hearth be adulterated by a lot of paper ash. It may be a little hard to interest the householder in the chemical reclamation of garbage. There is no scientific reason, however, why, in time to come, the garbage collector may not go away each week with his little cake of urea representing our total spoilage.

Wood will disappear in the kitchen where it assists insects and other vermin to develop. Metal and synthetic plastics are really better for this laboratory function. Metal furniture has a long way to go before it can replace all our wood which will eventually be recognized for what it is — one of the most beautiful materials in the world, to be treated with care, respect, and love. A whole paper could readily be written on new materials to be devoted to old uses.

Such a home will truly represent an evolution. The steps will be gradual and inoffensive to most people. There will, of course, always remain a large class of people reclaiming antique houses and bringing them into line with the advances of a decade ago. These people are kept constantly impoverished by their hobby, but they are very happy. It is unnecessary to say, however, that this type of house and activity does not appeal to Mr. John Q. Averageman.

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EDUCATIONAL OBJECTIVES AT M. I. T.

(*Continued from page 245*)

It is inevitable as the country has become more thickly settled, as the natural resources have been more completely explored and exploited, and as the country has rapidly accepted scientific and engineering developments, that competition should increase in all lines. In Europe the competition for desirable positions among technically trained men is much more severe than in this country which is still in its period of rapid development and expansion. Nevertheless, I think that we must inevitably face the fact that competition will become increasingly great so as to lead people to claim that there is an overproduction of men in the engineering profession, just as truly as in the agricultural or medical or any other profession.

The following figures throw some light on the present situation. Up until the time of the depression our graduates as a group found no difficulty in securing positions — in fact, practically all of them had accepted positions even before the time of graduation. During the past two years the situation has not been so favorable. By the time of graduation last June a little less than 50% of our graduating class had secured positions. Up to the present time about 90% of these men have positions. A survey made by the Society for the Promotion of Engineering Education, made during the past summer, showed that at that time about 33% of all graduates of engineering schools of the country had found work.

These facts lead to several interesting conclusions. The first is that up to the time of the depression there was no indication that competition was preventing our graduates from easily securing good positions. Even in the depression our men have fared reasonably well, although it is without doubt true that many have been forced to accept a type of position which would not have been their first or second choice. Since we believe the depression to be a temporary situation, there is no reason for alarm about the placing of our men in the near future.

If, however, we take a look ahead and plan wisely for the future, I think we are forced to conclude that we are steadily and gradually approaching the time in which highly desirable positions will be available only to men of exceptional training and natural ability, whereas men of mediocre attainments will have to be content with humbler positions. I believe that it is this situation which has led to the rapid development of postgraduate training for engineers during the past decade.

With this background I believe that the M. I. T. can face the future with confidence provided that it shapes its policies to meet these gradually changing conditions. It is our desire to continue to be the leading technological institution in the country in leadership, prestige, and service to the engineering, scientific, and architectural professions. In order to maintain this position I believe that the following policies are essential:

(1) We must maintain an instructing staff consisting of men who are not only inspiring teachers but who are recognized leaders in their professions.

(2) We must be a center of active pioneer development in extending the field of knowledge and improving the art in our professions. In other words, we must main-

tain a position of intellectual leadership, looking always ahead and anticipating the lines of future development.

(3) We must concentrate our attention and efforts upon students whose natural ability, character and previous preparation are such as to qualify them for positions of leadership in their professions.

(4) We must not admit more students than we can handle advantageously with our limitations of staff and equipment. The ideal situation would be that in which we have just so many students that if we had any more the quality of their training would begin to suffer.

(5) It is important that we should develop more mutually helpful contacts with important industries. Our coöperative courses in electrical manufacture, electrical communications, public utilities, and our practice schools of chemical engineering, have been outstandingly successful and beneficial to the coöperating industries as well as to the students. We know where there are similar opportunities in other fields where real contributions could be made to the development of the industries as well as to an outstanding type of educational training for the students, but which are not being carried out because of lack of financial backing or because of certain conditions within the industries which at present block the way.

It is important that more of the great industries should adopt the far-sighted point of view which a few of them now have, in which they make an investment for the future by contributing financially to the training of experts and the increase of knowledge in the fields in which their development depends.

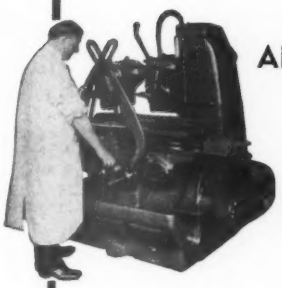
(6) Finally, we must foster all of those contacts which are stimulating to the instructing staff and helpful to our graduates. Such contacts include active participation in the affairs of the learned and professional societies; close and mutually helpful contact with industrial organizations and important problems in the professions; close contact with alumni through alumni officers, clubs, classes, and committees which can assist us by their advice in the selection of students and in the conduct of our teaching work through their practical experience, in the raising of funds necessary to carry out important projects, and in general in the maintenance of close relations between the academic side of the Institution and the practical world which we aim to serve.

TRANSATLANTIC

(*Continued from page 255*)

In Leipzig my cousin, Professor Lichtenstein, took care of me, and I had a large audience (for a mathematical lecture) at my lecture. Debye was away at the moment, and so was Heisenberg, but I met Hund, Van der Waerden, and Koebe, as well as our own Dr. Kirkwood of the Physical Chemistry Department.

In Berlin they much regretted losing Eberhard Hopf to our Mathematics Department. My talk was followed by one by Professor Schouten of Delft, who was in town to negotiate a partial fusion of the *Revue Sémestrielle* and the *Jahrbuch über die Fortschritte der Mathematik*. Schouten spoke on the new Einstein-Mayer work, which is in essence the same geometry (*Concluded on page 268*)



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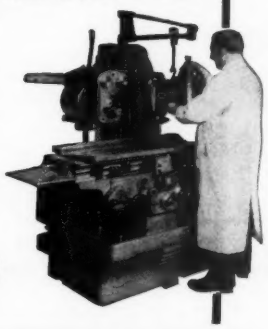

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TRANSATLANTIC

(*Concluded from page 267*)

as that recently discussed by Veblen and Whitehead, whose work is in turn an amplification of a paper by Dr. Struik and myself in the M. I. T. *Journal of Mathematics and Physics*.

I met Rüdenberg, who wished to be remembered to his friends at M. I. T., and is much depressed over the general economic situation, and obtained through him an introduction at Siemens and Halske. The plant of this company at Siemenestadt in the suburbs of Berlin is marvelous. The staff impressed me as very much like the group of young engineers and technicians one meets at the Bell Telephone Laboratories.

I gave the introductory paper at a meeting of the London Mathematical Society on Generalizations of the Fourier Integral. Watson, Titchmarsh, and others also spoke, and Hardy gave the closing address. There is much activity in that field at present.

My course on Fourier Integrals at Cambridge is being given twice a week at Trinity. With Hardy's course on Fourier series and Besicovitch's course on Almost Periodic Functions, that region of analysis is better represented this term than, I am told, is usual.

I had a talk with Professor G. I. Taylor yesterday on his plans for the study of turbulence in wind tunnels by the cooling of minute red-hot platinum wires. This is a beautiful chance for the use of methods of generalized harmonic analysis in a very practical problem. We could join forces with him effectively, with our splendid laboratory facilities. Otherwise the term is too young for me to have got much into the swing of new work.

NORBERT WIENER

INSTITUTE GAZETTE

(*Continued from page 260*)

to meet with alumni groups in Philadelphia, Wilmington, Baltimore, Washington, Harrisburg, and Pittsburgh. In April Dr. Tryon goes to Cincinnati, and this spring, Dr. Rowe, will be *en tour* with stands at Atlanta, Birmingham, New Orleans, and way stations.

The 156th Council Meeting

RECENT Council meetings have been devoted almost entirely to Alumni and Institute affairs. The last one, however, which met on January 25, stored away its intramural problems and sat itself down to be informed on the business depression by two members of the Institute's Department of Economics. What Professors Davis R. Dewey and Ralph E. Freeman had to say has already been published in part in the pages of The Review. Dr. Dewey presented a beautifully lucid address on "Forces and Phases of the Present Economic Situation," while Dr. Freeman spoke on "The International Financial Dilemma." These two addresses precipitated a discussion of some duration, the participants including Dr. (*Concluded on page 270*)

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INSTITUTE GAZETTE

(*Concluded from page 268*)

Compton, Giles Taintor, '87, Hollis Godfrey, '98, Paul D. Sheeline, '19, Percy R. Ziegler, '00, Cleon R. Johnson, '11, and others.

The Council did not give itself entirely over to instruction, but performed the usual amenities and heard the customary reports that invariably go with Council meetings. Vice-President Donald G. Robbins, '07, as presiding officer, called upon Charles E. Smith, '00, Vice-President of the New Haven Railroad, and new representative of the New Haven Club, to rise and be introduced to those present. Colonel Samuel C. Vestal, who was unfortunately absent on the occasion of the Alumni Guest Night in October, was present at this meeting and he was also asked to rise and be presented as the new Professor of Military Science and Tactics in charge of the Department. The Secretary presented the report of the Nominating Committee and gave a detailed account of recent visits to Alumni Clubs by Institute professors and officials.

INDUSTRIAL EQUILIBRIUM

(*Concluded from page 247*)

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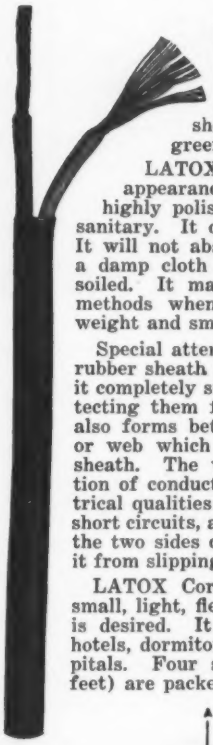

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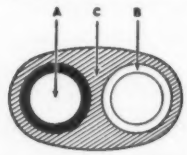

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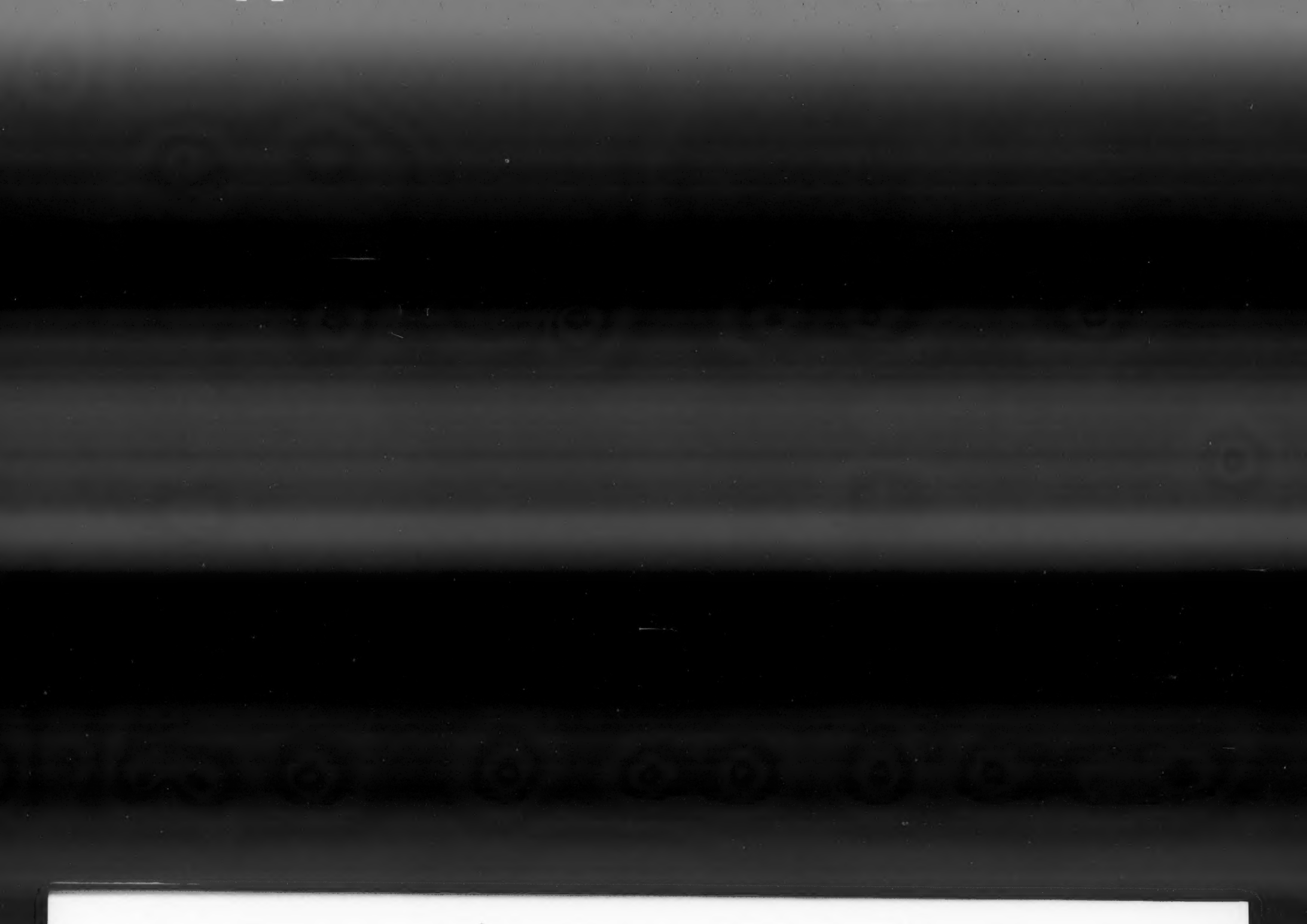
THE TABULAR VIEW

HENRY NORRIS RUSSELL, author of the article on spectroscopy, page 279, is Director of the Princeton University Observatory and is a Research Associate at the Mount Wilson Observatory. He is internationally famous for his contributions to astrophysics and mathematical astronomy, and has received many scientific awards for his work. President Hibbard, several years ago, remarked that only three men had received Princeton's Doctor of Philosophy degree in physics with the designation of *summa cum laude* — President Compton, his brother, Arthur H., and Dr. Russell. The paper which we present by Dr. Russell is an abstract of a lecture delivered here at M.I.T. under the auspices of the American Institute of Physics during the joint convocation of the American Physical and Optical Societies in February. ¶ The illuminating discussion, beginning on page 282, of German engineering education and of the social position of the German engineer was prepared by two professors of the Technical University at Karlsruhe. DR. THEODOR REHBOCK is internationally known for his contribution to engineering. Among some of his engineering achievements was the designing of the great cantilever bridge across the River Weser. Following this, he traveled to all parts of the world and in coöperation with Fredrich Krupp he made the plans for the defense works at the mouth of the La Plata River and the Bay of Bahia Blanks in South America. He headed an expedition in South Africa which surveyed the possibilities of utilizing its water resources for irrigation. As Director of the Hydraulics Laboratory at Karlsruhe, he has been connected with many great hydraulic projects, pursuing his study of river control and river flow problems, and in the spring of 1929 he lectured at the Institute on his work in these fields. ¶ EMIL PROBST, aside from his work as Professor at Karlsruhe, has practiced as a consulting engineer in concrete and reinforced concrete construction. He is Editor of the magazine *Der Bauingenieur* (Civil Engineer). Dr. Probst is a member of the *Verein Deutscher Ingenieure*, the Society of American Military Engineers in Washington, and Honorary member of the American Academy of Arts and Sciences in Boston.

THE account of George Eastman's relations with M.I.T. on page 284 was prepared for The Review by Carl W. Ackerman, Director of the Columbia University School of Journalism. ¶ In commenting on the death of Mr. Eastman, President Compton said: "The Massachusetts Institute of Technology owes to Mr. Eastman not only the greatest portion of its present material resources, but also reinforcement of its purpose to be of service. First as the 'Mysterious Mr. Smith' and later as its recognized benefactor, this institution has honored Mr. Eastman and has been one of the instruments through which he served his fellow men. The Corporation, Alumni, Faculty and Students all mourn the passing of a great benefactor and a great man."